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Methods for estimating the number of participants and value of recreation for coastal access point*s*

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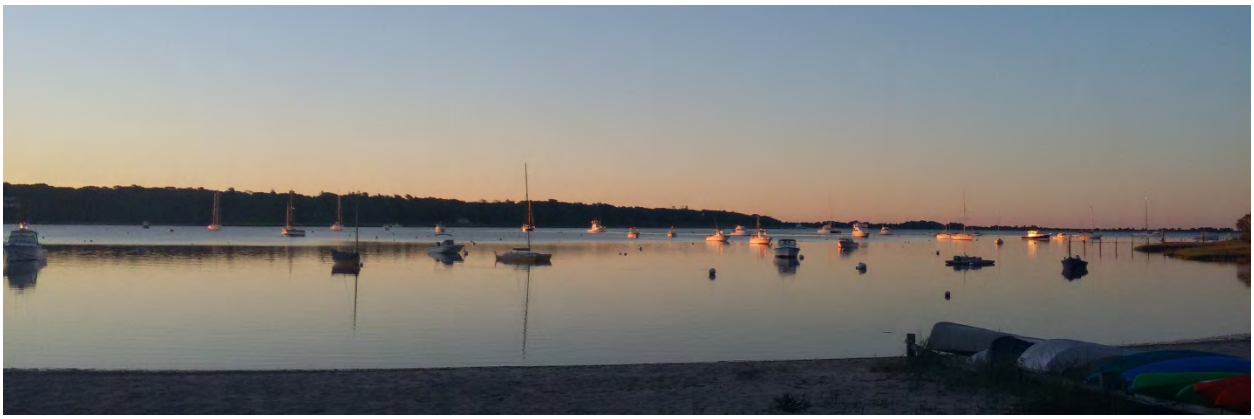

KEY POINTS

- This report presents tested methods that can be applied relatively easily and quickly using onsite observations to estimate total daily visitation to coastal access points for which daily counts are not generally taken.
- These methods can be used at both small and larger water access points common to estuaries and other coastal areas and can account for various uses at these locations.
- These methods do not require interrupting recreators with surveys.
- We provide instructions to walk the user through the methods step-by-step, illustrated with example applications to the Three Bays estuary system on Cape Cod, Massachusetts, and to selected sites around Narragansett Bay, Rhode Island.
- Along with this report are data sheets for recording observations and spreadsheets to compile data and apply the models to estimate total visits from counts of cars and people at public access points. Both the data sheets and spreadsheets can also be recreated easily.
- We include functions for estimating economic values, in dollar terms, for beach use. They can be used to estimate the value of the total use, or of lost use, of coastal areas from events such as a beach closure.

ACKNOWLEDGMENTS AND DISCLAIMER

The views expressed in this report are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Any mention of trade names, products or services does not imply an endorsement by the U.S. Government or the U.S. Environmental Protection Agency. The EPA does not endorse any commercial products, services, or enterprises. This contribution is identified by tracking number ORD-038594 of the U.S. Environmental Protection Agency, Office of Research and Development, Center for Environmental Measurement and Modeling, Atlantic Coastal Environmental Sciences Division. We would like to thank Katherine Canfield, Giancarlo Cicchetti, Justin Bousquin, Robert Griffin, and Peter Freeman for their thoughtful reviews.

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DEFINITIONS

All defined terms are italicized in their first use within the text of this report.

Benefit transfer – the use of existing estimates of non-market values from one or more studies to estimate a value for a location or locations other than the original study sites.

Cars – any passenger vehicles parked at a site.

Consumer surplus – also referred to as "net willingness-to-pay." This is the amount someone would be willing to pay above and beyond any amount actually spent for the good or service (such as an entrance or parking fee to visit a beach). Economists use consumer surplus to evaluate social benefits in benefit-cost analysis.

Continuous count – a count of all people and/or cars arriving to and/or leaving a site over a period of time (e.g., afternoon hours between 12:00 pm to 4:00 pm or from sunrise to sunset) in order to get the total arrivals and departures for that time period.

Direct economic contribution or impact – the money spent in a specified region on purchases and trip expenses related to particular activities in that region.

Economic benefit or value – when measured in monetary terms, is the amount of money that an individual is willing to give up, to obtain a particular good or service.

Extrapolation factor – Sometimes referred to as "turnover factor", this is the ratio of the total cars or people present at a site over the course of a day to the total cars or people present at a particular time (the **stock**, see below). The extrapolation factor for people or cars for a given time is multiplied by the **periodic count** (snapshot at a particular time) of people or cars at that time to estimate visitors for the whole day.

Non-market value – the value people place on goods and services that are not directly bought and sold in markets, including many ecosystem goods and services. In the context of this report, visiting a recreation site provides a non-market value. Non-market values are a type of **economic benefit or value**.

Periodic count – a count of people and/or cars at a specific time during the day to provide a snapshot of the number of visitors.

Representative sample – a selection of days and times designed to accurately reflect visitation for a larger window of time, e.g. a month or season.

Sample – a selection of days and time windows in which people and/or car counts are conducted.

Stock – the number of people and/or cars present at a point in time. The stock for a specific time is calculated as total arrivals minus total departures up to that point in the day. Stock estimates can be compiled more simply by using periodic counts at given times.

Stock curve – a graph of the stock of people and/or cars at a location over the course of a day, estimated from counts of arrivals and departures, or estimated using periodic counts throughout the day.

Stratified sample – A selection of days and time windows chosen to measure visitation across an attribute of the day or time. You might design multiple representative samples for types of days (weekends and weekdays), for example.

Trip – a visit to the coast to engage in recreation that can be a single day, part of a day, or multiple days in duration.

Trip expenses or expenditures – the total amount spent during a recreation trip that is related to the recreation activity or activities (such as transportation costs, food, lodging, entrance fees, etc.).

Visitation (daily) – the total number of people throughout a day who engaged in coastal recreation in a specified geographic area (e.g., a beach or coastal access point).

Visitation (seasonal) – the total number of daily visits throughout a season in a specified geographic area (individual people may be counted more than once).

I. INTRODUCTION

Estuaries support many recreational opportunities for both residents and visitors. Coastal recreation provides significant *economic impacts and economic value*[1] to states and communities (for a review, see Pendleton 2008). In 2012, nearly 49 million people participated in ocean recreation in the United States, with over 1.2 billion days spent on ocean recreation (Kosaka and Steinback 2018). The economic impacts from total equipment and *trip expenditures* for these activities were more than $141 billion, supporting 3.1 million jobs and contributing $225 billion to the U.S. gross domestic product (GDP) (Kosaka and Steinback 2018).

In addition to these economic impacts in the form of direct expenditures, economic values for coastal resources—the value to people above what they actually pay to enjoy a resource—are important. Many coastal recreational activities are free or have minimal access fees, yet are still valuable, providing economic value in the form of *non-market values* to society. Non-market values can be difficult to measure, often requiring surveys and other costly research. Understanding the aggregate non-market value of coastal recreation requires estimating two components of value: (i) visitation and (ii) the value per person per visit. Non-market values may be applied to estimate benefits from existing resources, such as the value of a beach day; or to estimate benefits or costs from a change in a resource, such as the value of reducing the number of days with swimming advisories or closures (Lyon et al. 2018).

As described above, in order to estimate non-market values, researchers and managers must know the visitation to a site or area. Understanding visitation is also important in contexts other than measuring economic values. Communities may want to know how many people are using their coastal access points in

[1] All italicized terms are technical language explained in the Definitions section at the beginning of this report. Technical terms are italicized upon their first use in the report.

order to better understand demand for coastal access, provide public services, plan for infrastructure needs, and more.

Many coastal recreation managers lack the capacity to collect and maintain accurate daily visitation records. In this report, we present three different methods that managers can use to estimate the number of people who visit coastal locations for recreation. These methods require minimal investment of time and money while providing estimates sufficiently accurate for most management purposes. We demonstrate use of the methods through examples from the Three Bays estuary system in Barnstable, Massachusetts (Cape Cod) and locations on Narragansett Bay, Rhode Island.

Actions to reduce water quality impairments can be expensive and difficult to implement. Understanding the number of people who use estuaries provides important information to decision makers regarding how many people are affected by poor water quality and could benefit from improvements. Despite its utility, there is very little information available about the number of visitors to estuaries because of the complexity of applying the traditional methods used to calculate visitation. In response, we sought to develop methods to more simply estimate visitation to these areas.

Why quantify coastal recreation?

In making decisions about management or justifying programs it is often useful for communities, states, or regions to quantify recreational uses of coastal areas and the value of those uses to the public. Understanding the number of visitors and their values for coastal recreation can be important in many management or policy contexts. These include understanding the benefits of improving water quality or other environmental improvements, protecting or supplying additional public access points, understanding the extent of tourism in an area, making decisions about investments in infrastructure or amenities at access points, assessing damages from environmental incidents, and others.

While estuaries are likely to have high levels of recreational use (Mulvaney et al. 2019), they are also less likely to have visitation data. In fact, combined total visitation at the small access points in an estuary may be equivalent to or higher than at nearby large coastal beaches. Visits to estuaries often represent different types of users and uses (Mulvaney et al. 2019). Some of the larger access points where parking fees are collected, primarily beaches and parks, may use collected fees to approximate visitation. However, visitation estimated from daily fees may not include residents with season passes or those who visit outside of normal operating hours. Therefore, daily use counts that rely on collected fees generally underestimate total visitation. Smaller access points, many of which are in estuaries where environmental quality tends to be more of an issue and which may be more used by underserved populations, rarely collect fees and typically lack other visitation measures.

II. METHODS

Overview of the methods

- In this report we present three ways to estimate visitation to coastal access points that use observational approaches and do not require surveys of visitors.
- The methods are not intended to be precise, but to give "ballpark" estimates with minimal investment of time and money, and with only basic expertise.
- The accuracy of the methods, when applied to locations outside of our study area, will vary depending on how similar the new locations are to those in our study and how much effort is applied to collecting site-specific data. Accuracy of the methods presented here compared favorably to that of more time-consuming and complicated approaches.
- Each of the methods provides estimated visitation for a single day or set of days for specific sites. These estimates are snapshots in time for the days when counts are conducted, based on conditions at each location on those days (e.g., weather, day of week, time of season). The number of visitors can be tracked over time and across conditions using multiple counts. The counts can also serve as a baseline for evaluating the impacts of a discrete event, like beach closures, fish kills or oil spills, that may disrupt visitation.
- We provide additional methods that use those days' data to estimate visitation to sites for a complete week, month, or season. These longer-term estimates will be more accurate if more daily counts, across more conditions, are included.

Approaches to estimate the number of people using coastal access points

Based on our studies for Three Bays and Narragansett Bay, we present three ways to estimate visitation. They vary in the amount of time and effort needed to compile information and the resulting accuracy of estimates. The core element in all three approaches is the application of *extrapolation factors* to periodic counts of vehicles or people at an access point a certain time, in order to estimate total visitors to that place over an entire day. Multiplying the periodic count by the extrapolation factor gives an estimate of total daily visitation. Figure 1 illustrates this process, whereby all-day counts plus periodic counts are used to calculate extrapolation factors. These factors are then applied to new periodic counts to estimate visitation for a different day or location.

The three approaches to calculate and use extrapolation factors are shown in Figure 2 as boxes and vertical arrows. Approach 1 uses periodic counts multiplied by existing extrapolation factors (such as those from our study – provided in Appendix A) to estimate total daily visits for a different day or site. Approach 2 uses a four-hour continuous count to adjust existing extrapolation factors; these adjusted extrapolation factors are then applied to periodic counts to estimate total daily visits. Approach 3 uses all-day counts to calculate new location-specific extrapolation factors, which can then be applied to periodic counts to estimate total daily visits for days when all-day counts were not conducted. The horizontal arrows at the bottom of the figure illustrate that site-specific accuracy increases with the time and effort invested to implement the more complex approaches. See Mulvaney et al. (2019) for details of the derivation of the methods underlying these approaches.

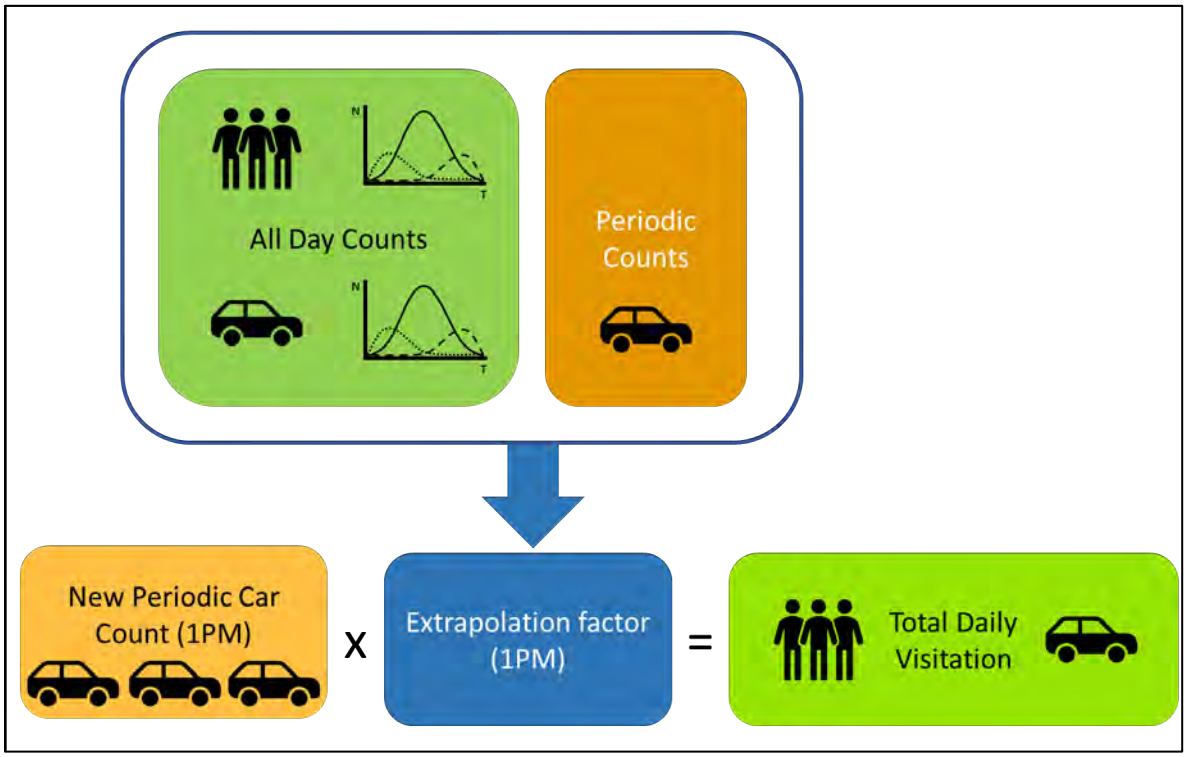


Figure 1. Estimating daily visitation using extrapolation factors and periodic counts. The methods described in this report allow for estimating total daily visitation to a coastal recreational site using

extrapolation factors and periodic counts. The extrapolation factors are developed from all-day and periodic counts – shown in the upper blue-outlined box. (We provide these from our study, or you can calculate your own). These extrapolation factors (the lower blue-shaded box) are applied to new periodic counts (the lower orange-shaded box) to estimate total visits for the day at a site (lower green-shaded box).

Approach 1 – single periodic count(s). To estimate daily visitation at a site, the simplest approach is to take a single periodic count at the site, at a particular point in time, and multiply by the associated extrapolation factor provided in this guide (Appendix A). We calculated these extrapolation factors based on our all-day and periodic counts for Three Bays from the summer of 2017. The primary goal of this guide is to enable practitioners to use this approach. Approaches 2 and 3 are designed to tailor the extrapolation factors to specific sites for future uses of Approach 1. We provide an example of Approach 1 that applies our extrapolation factors to counts taken by University of Rhode Island researchers in the summer of 2018 at 16 locations in Narragansett Bay. This approach has the lowest site-specific accuracy but is the fastest and easiest to implement. It is most appropriate for locations and contexts where a very quick and easy estimate is needed.

Approach 2 – four-hour continuous count plus periodic counts. The second, slightly more complicated, approach adapts the Three Bays extrapolation factors to a different area by conducting *continuous counts* of cars and people over a four-hour window of time during the day (from 12:00 pm to 4:00 pm). These new continuous counts are used to develop adjusted extrapolation factors, which are then applied to periodic counts to estimate all-day visitation for other days and/or sites. For our study, we conducted four-hour continuous counts at several public access sites within Narragansett Bay and used these to adjust the extrapolation factors we found in Three Bays. We demonstrate how to do a similar study for your area. This approach increases accuracy by tailoring the estimates to be more appropriate for your estuary and is still relatively easy to implement. It is most appropriate when you want to use a fairly quick and easy approach but want to better capture local conditions.

Approach 3 – all-day continuous count plus periodic counts. The third and most time-consuming approach is to replicate the study methods used in Three Bays by conducting both all-day and periodic counts of people and cars to calculate your own extrapolation factors. Although this approach requires more time and people, it is also the most accurate as the factors that influence visitation are likely to vary depending on the type of access and characteristics of the surrounding area. This approach is most appropriate when you want estimates specific to your estuary and have the staff and time to carry it out.

Below, we describe how to apply each of these approaches, illustrated with examples from our work. We also explain how to use the Excel spreadsheets and data collection forms that accompany this report to collect and enter your data and calculate total visitors.

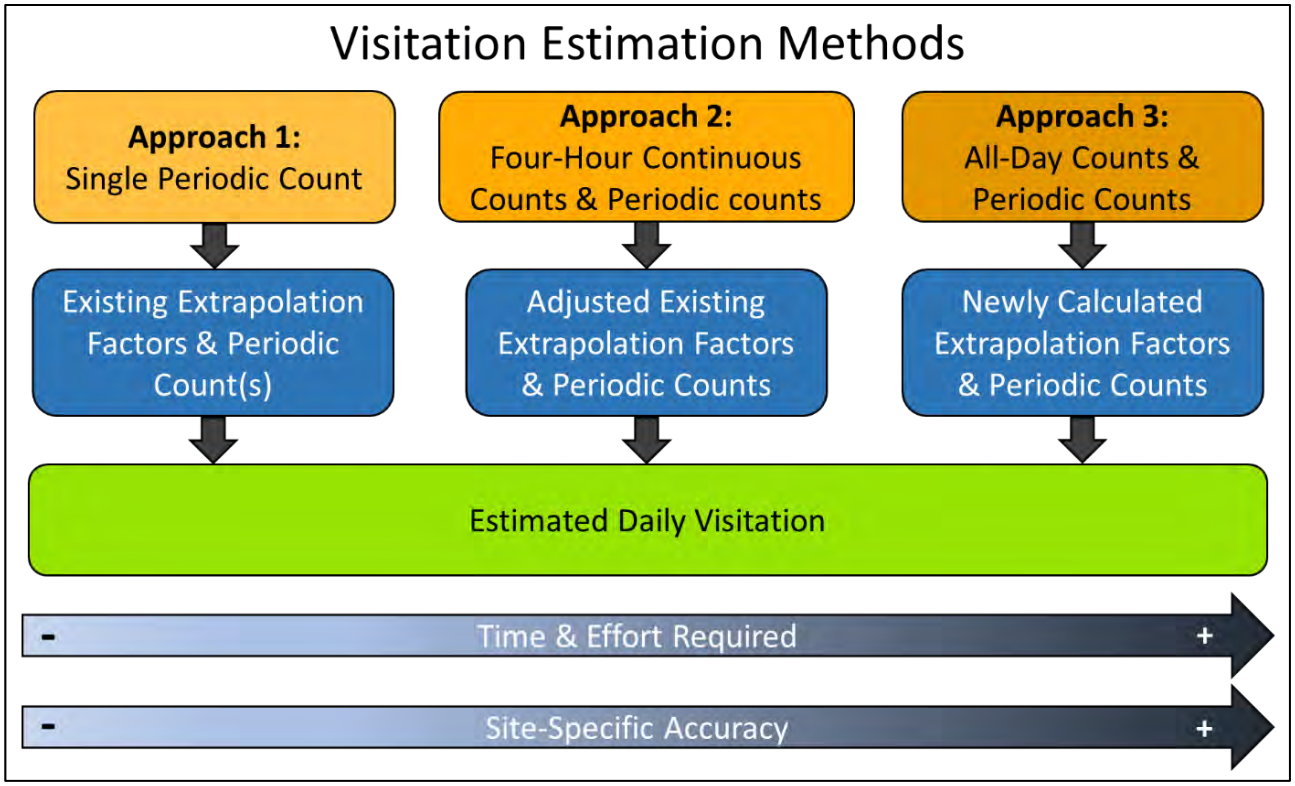


Figure 2. Illustration of the three approaches. The three approaches to calculate and use extrapolation factors are shown as boxes and vertical arrows. Approach 1 uses periodic counts multiplied by existing extrapolation factors (such as those from our study – provided in Appendix A) to estimate total daily visits for a different day or site. Approach 2 uses four-hour continuous counts to adjust existing extrapolation factors; these adjusted extrapolation factors are applied to periodic counts to estimate total daily visits. Approach 3 uses all-day counts to calculate new location-specific extrapolation factors, which can then be applied to periodic counts to estimate total daily visits for days when all-day counts were not conducted. The horizontal arrows at the bottom of the figure illustrate that site-specific accuracy increases with the time and effort invested to implement the more complex approaches.

Derivation of extrapolation factors

The simplicity of the three approaches described here depends on extrapolation factors to convert periodic counts to all day counts, as described above. These are sometimes referred to in the literature as "turnover factors" (King and McGregor 2012). Multiplying the number of people or vehicles from a periodic count by the extrapolation factor gives an estimate of the total number of people who visit in a day (Figure 1). Extrapolation factors vary by hour of day, based on how use is typically distributed over the course of the day and how long people tend to stay on site. During the day, people arrive and depart at different times, resulting in a *stock* of people on site at any given time that would be counted in a periodic count. Typically, the number of visitors increases over time up to a maximum during peak hours (early afternoon for most sites), and then decreases later in the day, as illustrated in Figure 3 (see Mulvaney et al. 2019).

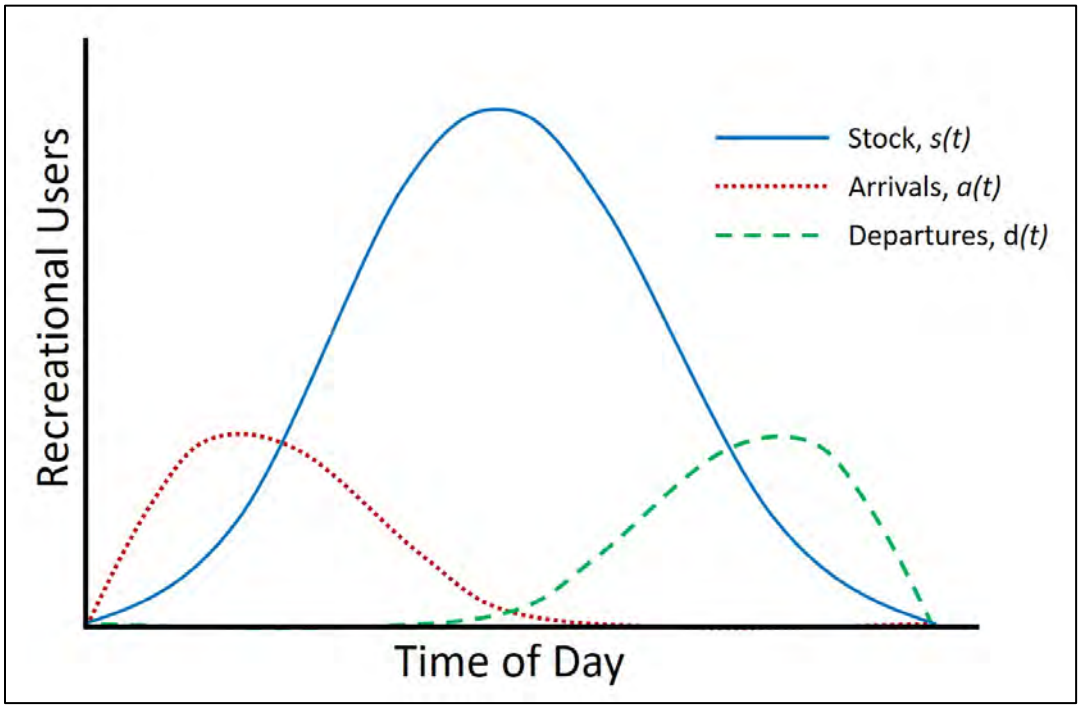


Figure 3. Stock of recreational users: The stock of recreational users at any one time in the day is the difference between the cumulative arrivals and departures up to that time. The *stock curve* is the solid line. Adapted from Banzhaf (1996) and Leggett (2017).

> ***Example*** - In our Three Bays study we used all-day (sunrise to sunset) counts on randomly selected summer days at 11 locations to develop stock curves for visitors and cars. To do so, we recorded arrivals and departures within our demarcated boundaries of both individual people and cars for each 15-minute increment. Later, we grouped counts into hourlong blocks and developed the stock curves. From these stock curves, we calculated extrapolation factors that relate the stock of either people or vehicles on site at any given time to the total number of people visiting over the course of the day. We created an average extrapolation factor for each hour of the day, corresponding to the changing distribution of visitors over the course of the day (Figure 4).

We found that car counts provided a more accurate way to extrapolate from periodic counts to total visitors for a day. This is because people who have entered the site—particularly boaters—often do not remain within the boundaries of counting, but cars remain parked as long as the people who entered are still engaged in recreation from that site. Periodic counts of cars are also more easily and quickly accomplished. We focus in the rest of this guide on the vehicle extrapolation factors.

The extrapolation factors can be used to estimate total visitors from sunrise to sunset on a given day, based on a single periodic count of cars taken at a specified time during that day. To do this, the periodic count of cars is multiplied by the extrapolation factor for the appropriate hour to estimate total number of visitors.

Example **-** Using the extrapolation factors that we present in Figure 4, if 26 cars are counted at 4:00pm, we would estimate a total of 275 visitors for the whole day (26 * 10.57). We have automated these processes in a spreadsheet that accompanies this report. We found that this extrapolation method is more accurate when periodic counts are taken during the peak afternoon hours (12:00pm to 4:00pm), because, for most locations, these hours capture a larger proportion of a day's visitors. This is illustrated in the graph in Figure 4, where the lower extrapolation factors have the tightest confidence intervals.

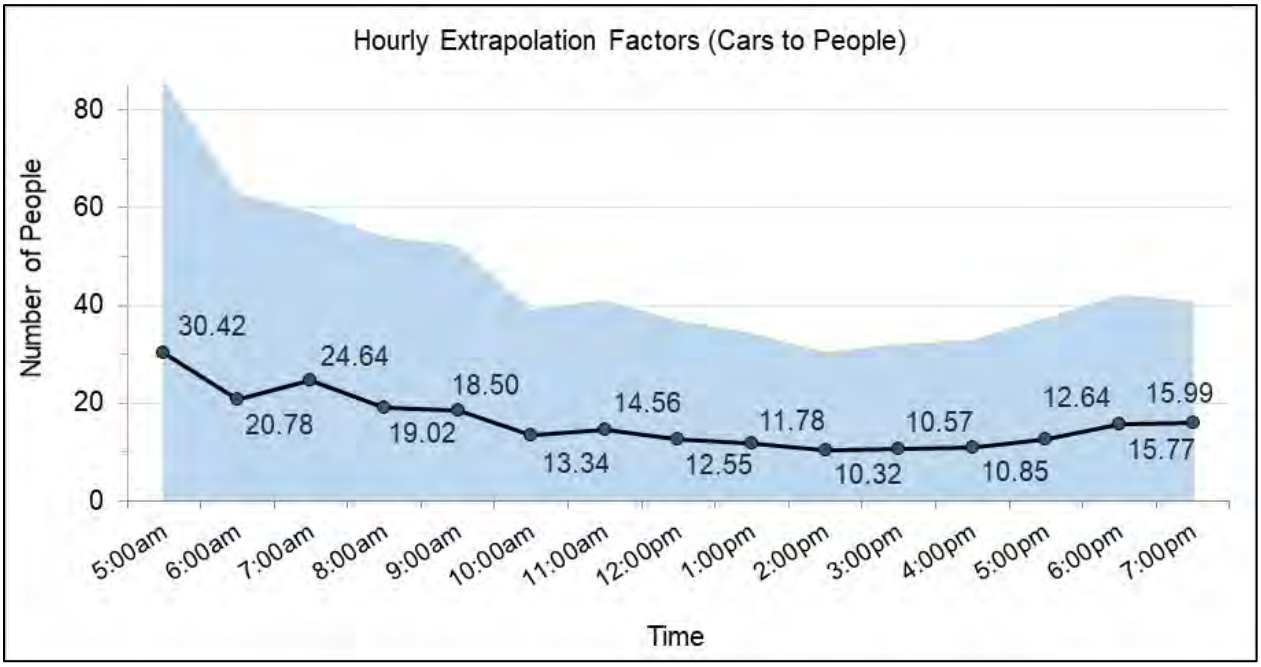


Figure 4. Hourly extrapolation factors for Three Bays. The extrapolation factors translate the number of cars counted at a given time to the total people visiting a site in a day. On the graph, one car counted within an hour translates to the number of people shown. The figure shows the average factor by hour and the 90 percent confidence interval (the shaded area). The confidence intervals were estimated based on a gamma distribution fit with the method of moments statistic matched to each hour's extrapolation factor from our sample.

Researchers set up for a day of counting at one of the Three Bays sites

III. THE PROCESS

Here, we walk through the four-stage process for applying each of the three approaches (Figure 2) to estimate visitation to a particular location. The approach you select will depend on the level of accuracy you want your estimate to achieve for your specific sites, as well as the time and personnel available to collect data. Additionally, depending on the complexity of counting people or cars at a site, a particular approach may be more feasible than others. These considerations, along with the objectives of your study and how you wish to use the results, will help determine the appropriate approach to use. The calculation steps and equations for each approach are included in Appendix C.

We have broken down the process into four stages (Figure 5) and provide you with examples and with materials for getting started.

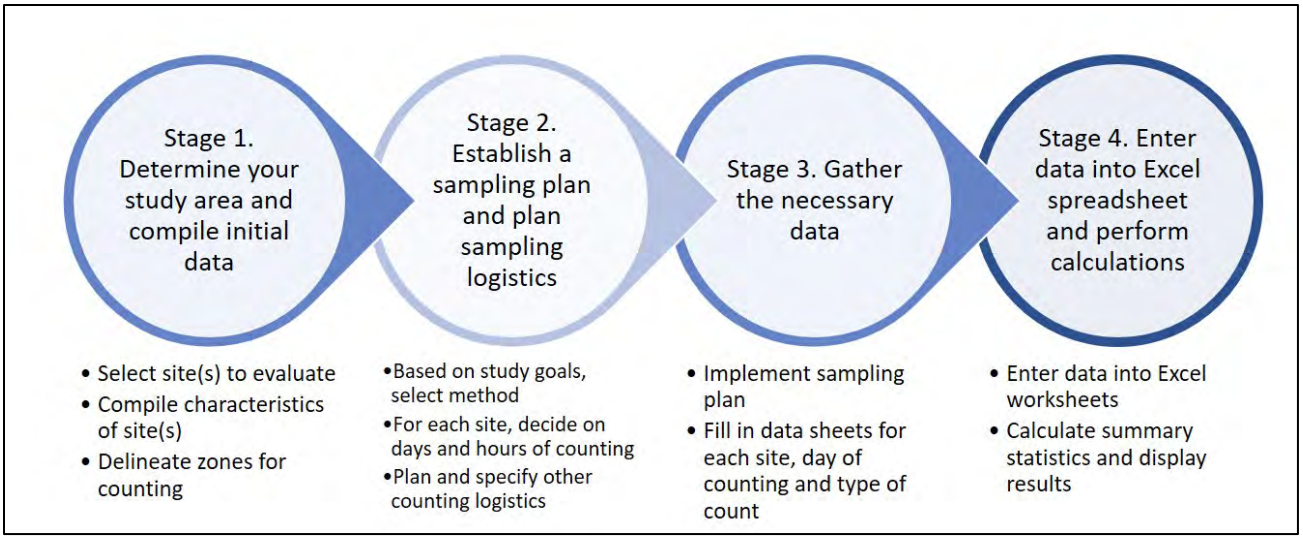


Figure 5. The four stages of implementation.

Stage 1. Determine your study area and compile initial data

- **Select access point(s) to evaluate.** First, determine site(s) for which you want to estimate visitation based on the objectives of your study. Ideally, each site will be easy to delineate from the surrounding area, provide public access to the water, and provide at least some parking.

> ***Example*** – In our Three Bays study, we wanted to estimate recreational use for all public access to the Three Bays estuary system over the course of the summer season. Three Bays is a 1,251-acre (1.95 square miles) estuary system comprising three connected, primary bays (Cotuit Bay, West Bay, and North Bay), along with several smaller sub-estuaries. To begin, we defined all public access points that were feasible to count in the system. Conducting counts at some access points was not feasible. For example, there was a town-recognized public access bulkhead that was next to two different private marinas. At this location, it would have been difficult to distinguish between public and private use. At a few other access points, signs were posted indicating coastal access, but the town did not maintain access, people were not informed of its existence, and getting into the water at those sites would have been difficult. These locations were not included in our study. The final set of access points we chose to observe included 11 public access sites around the estuary (Figure 6).

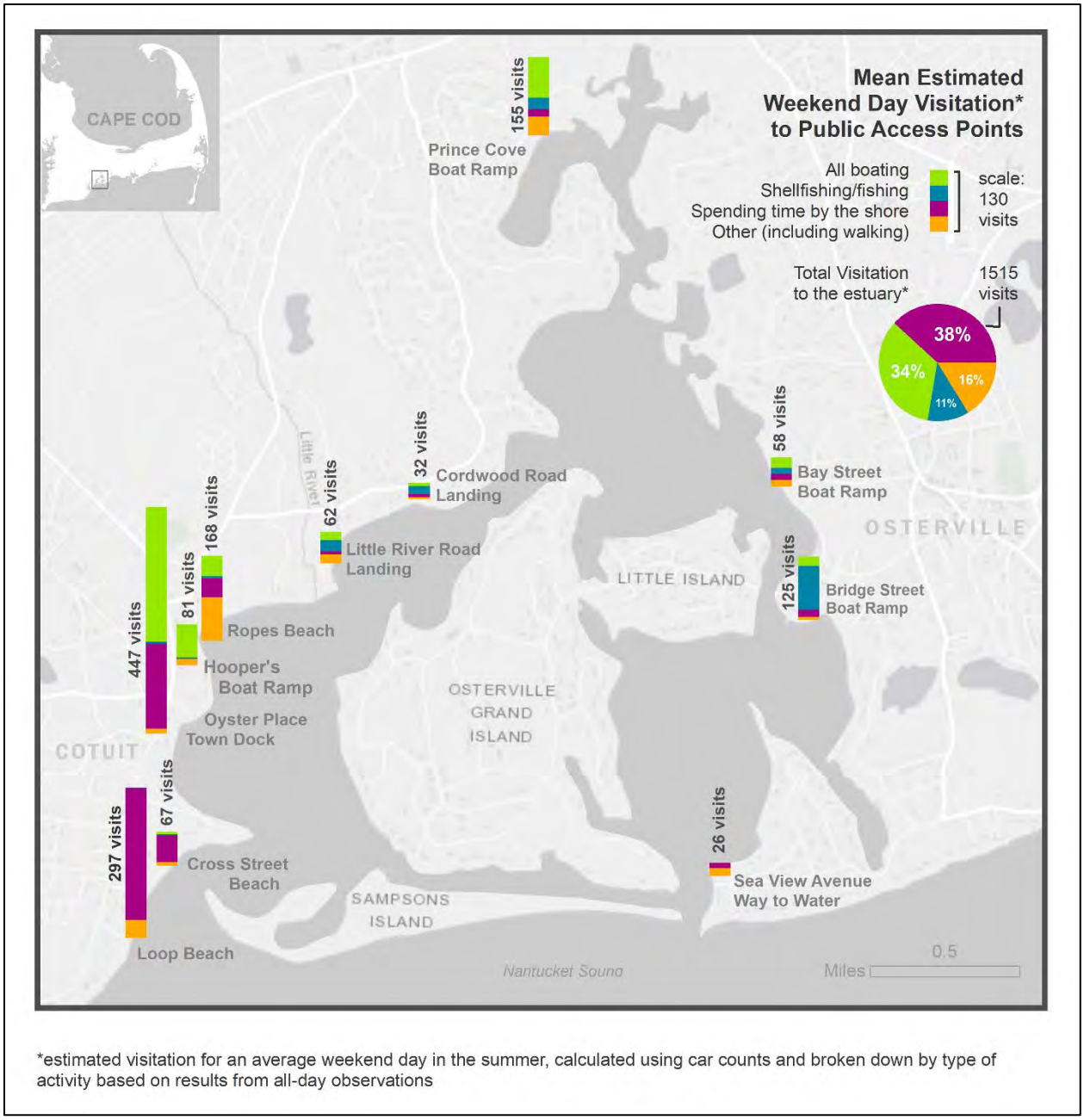


Figure 6. Map of Three Bays and the 11 public access points used in this study. Each access point is described by type (i.e., boat ramp, beach, dock, landing, or way to water), number of available parking spots, and estimated recreational use for an average weekend day broken up by types of activities.

- **Compile general characteristics of the access point(s).** Important site characteristics include the specific location, type of access point (beach, boat ramp, dock, landing, etc.), who has access (resident only or general public), parking availability, size of the access point, and the number of entrances to the site. These characteristics help assess the feasibility of the site for counting, and the number of people who will be needed for the counting. For example, if the access point has multiple entrances more observers may be

needed in order to count at each entrance. General characteristics of the sites can be compiled using online maps, local knowledge, site visits, and more.

> ***Example*** – For Three Bays, there were three beaches, four boat ramps, two sandy landings, one town dock, and one end-of-the-road way to water (Figure 6). These were accessible to the public, but parking was by resident sticker only. All sites had at least three parking spots available for residents and only one entrance.

- **Delineate zones for counting and specify counting procedures**. For each site, you need to determine who counts as a visitor to that site. To do this, you should establish and map the spatial zones that represent the site prior to conducting the counts. These zones will depend on the layout of the site and should demarcate the parking area(s) associated with the site and the area that encompasses the recreational site itself. This takes a degree of judgement, but mapping with clearly demarcated lines provides a way to distinguish a recreational user in a consistent way and allows the various counts to be consistent across observers and days. See Appendix B for examples of zone maps. All team members should be briefed on the research plan and procedures prior to setup at the site, including how and when to count a person or car as "in" the site and the bounds of the sites. You should specify rules for whom to count, including whether cars are counted if no one gets out of the car, whether people who walk through the site will be counted, and so on. These should be decided based on best professional judgment. It may be helpful to do a test run with multiple counters to assure that people are counting consistently.

> ***Example*** – In our Three Bays study, we delineated zones at each of the access points for counting people and cars (Appendix B shows examples for 2 different sites). We used aerial photo maps overlaid with lines delineating the zones. Observers were provided with these maps. Once a vehicle or person entered the site boundary, that vehicle or person was counted.

Stage 2. Establish a sampling plan and plan sampling logistics. A sampling plan consists of deciding when to count at each of your selected site(s). The appropriate sampling plan will vary based on your goal.

Daily visitation to access point(s). Depending on which approach you use (1, 2, or 3), the sampling plan can be as simple as deciding when and how long you need to be at each site, given the available resources. This will depend on how many observers you have, as well as transportation abilities. A team with a minimum of two or three people at a site works best for all three approaches. Sites with multiple entry points may require more than one team. The more people on your team, the more locations you can cover in a day or the more breaks team members can take.

Approach 1- single periodic count(s): Approach 1 is designed for sampling many sites quickly, since all that is needed is a single count of how many cars are present in the defined zone(s). For most sites where, peak use tends to occur in the early afternoon, periodic counts are most accurate when conducted between 12:00 pm and 4:00 pm (times of higher use). Whether counting at one or many sites, plan for the observations to occur during these peak use times. A roaming observer may be able to sample many sites around an estuary in a single afternoon, providing daily visitation estimates for many sites or an entire

estuary. If you are estimating visits for sites with atypical visitation hours (for example, some fishing sites), you will want to consider using Approach 3 to estimate extrapolation factors that are more appropriate to these sites, and then conducting periodic counts at the times of highest use.

Approach 2 - four-hour continuous count plus periodic counts: This approach requires observers to spend four hours at each site on each sampling day, in order to collect data to adjust the provided extrapolation factors. Again, we suggest counting during peak hours, 12:00 pm to 4:00 pm. Because the observers must be onsite for multiple hours each team of two or three people can only cover one location in a day of sampling. The main sampling decision is figuring out which sites and which days you need counts. The number of sites and days that can be included will depend on available people and transportation. Since these four-hour continuous counts are conducted to make the extrapolation factors more site-specific, we suggest taking these continuous counts more than once per site or type of site; and across weekend days, weekdays, and different weather conditions. The more counts you can do on the various types of days, the better. This will provide a more *representative sample* of visitation through time. See the "Monthly or seasonal visitation" below for more advice on how to sample depending on the needs of the study.

Approach 3 - all-day continuous count plus periodic counts: This approach requires counting each site for the entire day, either from sunrise to sunset or for the portion of the day for which you wish to estimate visitation. The same team size limitation applies as in Approach 2; each team of observers can only sample one location in a day. In fact, with the longer sampling day, it is advisable to have the teams switch off midday or switch locations, making for a more pleasant day and more alert observers. As with Approach 2, all-day counts should be conducted multiple times across various types of days.

Monthly or seasonal visitation. When the goal of the study is to estimate visitation for more than simply the days when counts are taken, such as for a month or season, the sampling plan becomes important. In practice, given available resources and people, you will need to select a representative sample of days for counting. By sampling days that represent the various types of days that make up the month or season, you can better extrapolate to these longer time periods. Given that visitation will vary with weather, day of week, and month it is important to develop a sampling plan prior to counting, in order to develop an unbiased estimate. You can't just assume every day is 80 degrees and sunny! To do this, you select a *stratified sample* of days.

> ***Example*** – Monthly Visitation: You want to estimate visitation for the month of July and have resources for six sampling days for the site of interest:
>
> - Days in the month consist of weekend days and holidays (9) and weekdays (22) and you want a representative count of each type of day. Create two lists: (1) all the weekend and holiday days and (2) all the weekdays. Randomly pick 3 weekend/ holiday days and 3 weekdays before the month starts. The random selection of days will allow for variations in weather. You can use Excel's random number generator or print/write out the days and select them randomly from each of the 2 sets of days.
> - Conduct your counts on those selected days, rain or shine.
> - Average the counts for each type of day (weekend/holiday, weekday) from your 3 counts of each.
> - Multiply the average for weekdays by 22 (number of weekdays in the month) and the average for weekends/holidays by 9 (number of weekend/holiday days in the month). Sum the two totals to estimate visitation for the whole month.

Accuracy of the estimate will increase with more sampling days and thus more observations. In the example, we considered two day types – weekends/holidays and weekdays, but one could stratify across days of the week (Monday, Tuesday…..), or treat holiday days differently, or include other factors that might be important to variations in visits. However, each additional factor would increase the required number of sampling days. All sampling plans are a tradeoff between accuracy (more counts) and effort.

To estimate visitation for a whole season, the same concept of the stratified sample holds. First, create a list of the types of days and months in the season. The groups might be weekends/holidays in June, July, and August; weekdays in June, July, and August; and so on for additional months. The plan would be to sample days randomly within each of these groups in order to be able to estimate season totals using the number of each type of days and the average count for each.

> ***Example*** – Seasonal Visitation: In our Three Bays study, we conducted all-day counts (Approach 3) on seven days during the summer of 2017 (June-August), sampling two or three sites on each of the seven days. To capture a representative sample of summer use, we stratified our random sampling days across weekdays and weekends and across each type of day in each month. We counted visitors on at least two days in each month. For each sample day, we randomly selected sites by access point type (beach, boat use, and landing or way to water) to ensure there were at least two different types of access sampled on any given date. Over the course of the season we conducted an all-day count at each site at least once. This sampling plan ensured we captured a range of weather, time of the season, and type of access. At each site we had two or three researchers conducting the all-day count, while two others moved among all the sites and conducted periodic counts throughout the day (Approach 1) (Mulvaney et al. 2019).

These more complicated sampling design steps are optional, needed only if you are counting over multiple days in a season with the objective of using those daily counts to estimate total visits for the month or season. If that type of seasonal visitation is of interest, see Leggett (2017) and Mulvaney et al. (2019) for more information and examples on developing a sampling plan and randomizing across space and time.

Stage 3. Gather the necessary data. The data you collect will depend on which of the three approaches you have selected. We have provided printable templates to assist in collecting data necessary for estimating total visitation to your recreation area, and Excel spreadsheets for aggregating all collected data and calculating extrapolation factors and summaries. Table 1 lists the available templates and spreadsheets. The spreadsheets were developed with Microsoft Office 365, and are programmed with macros to enable variations in number of sites, number of days, and other factors. In the event that the spreadsheet macros do not function for you, you can use the example spreadsheets for Narragansett Bay as guides and apply the equations in Appendix C to perform your own calculations.

Table 1. List of provided templates, spreadsheets, and worksheets within spreadsheets

File Name	*Description*
Field Data Sheets.docx *Note: these sheets are also found in Appendix D of this document*	File that includes templates for printable data forms to fill out when counting (Stage 3). Includes sheets for: • Periodic Car Counts • Continuous & Hourly Car Counts • Continuous People Counts • Hourly People Counts • Site Conditions
Periodic Count data entry.xlsm	Macro-enabled spreadsheet for data entry and calculations (Stage 4) using Approach 1 – single periodic counts. Includes worksheets: • DataEntry – sheet to enter data collected in Stage 3 • Results – sheet that displays calculated estimates of total visits in various ways • StartHere and ResultsInfo – informational sheets to explain how things work • EstimatedDailyVisits and admin –sheets that contain data for calculations and the calculations. Keep these sheets locked and do not edit sunless you want to change formulas or data used in the calculations.
Periodic Count data entry NarrBay.xlsm	A copy of the periodic count data entry spreadsheet filled in with the Narragansett Bay data, to use as an example.
Continuous count data entry.xlsm	Macro-enabled spreadsheet for data entry and calculations (Stage 4) using Approaches 2 and 3 – continuous plus periodic counts. Includes worksheets:

File Name	*Description*
	• SamplingPlan – sheet to enter parameters of the sampling plan (sites, site types, activities, dates) • IncomingCount – sheet to enter continuous counts for each site and date • TopOfHourCount – sheet to enter hourly periodic counts for each site and date • Statistics – displays statistics describing the entered data • ExtrapolationFactors – summary of extrapolation factors calculated from entered data • Admin –sheet that contains data for calculations. Do not edit this sheet directly. It contains data from the underlying study and data populated from entries on the other sheets.
Continuous count data entry NarrBay.xlsm	A copy of the continuous count data entry spreadsheet filled in with the Narragansett Bay data, to use as an example.
WTP tool for beaches.xlsx	Spreadsheet containing a tool to estimate non-market economic value per day for beach visits, for different regions of the U.S. Includes worksheets: • Valuation Tool – sheet to enter parameters for valuation and display results • Admin –sheet that contains calculations. Keep this sheet locked to avoid changing underlying data from the valuation model.

Approach 1 - single periodic count(s)

This approach uses the data sheet for "Periodic Car Counts" in Field Data Sheets.docx (Figure 7; Appendix D). At your selected site(s) count vehicles within the parking zone(s) you delineated in Stage 1. To improve accuracy of applying extrapolation factors, it is generally best to count during the hours of 12:00 pm to 4:00 pm. On the data sheet, first enter observer name(s).

Then, for each count, enter:

1. Site name and type
   (example of site types are beach, boat ramp, landing, park, fishing access, wharf, way to water)
2. Date of count
3. Time of count
4. Number of vehicles counted within the designated zone(s)
5. Whether the lot is full
   (this is not used in the calculations, but can be useful information to determine capacity of a site)
6. Additional comments
   (for example, unusual events taking place at the site or unusual conditions)

The bottom of each sheet has spaces for entering the name or initials of the person entering the data, the date entered, and the data sheet number. These will be filled in when you enter the data.

EXAMPLE: Periodic Car Counts Observer Name(s) J. Doe

Site Name and Site Type		Date	Time	# Cars	Lot Full?	Additional Comments
Name	E. Greenwich	7/25/18	1:00 pm	7	Yes / (No)	
Type	Boat ramp					
Name	Oakland Beach	7/25/18	2:00 pm	30	Yes / (No)	windy
Type	Beach					
Name	B. Tuft Park	8/14/18	1:00 pm	8	Yes / (No)	
Type	Park					
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						

Data entered by: _____ Date entered: _____ Data sheet # _____

Figure 7. Periodic car counts data sheet with example data.

Approaches 2 and 3 - four-hour or all-day continuous count plus periodic count(s):

At your selected site(s) and on your selected sampling day(s) count cars and people entering the site during each half hour time period (continuous car counts, continuous people counts), as well as total cars and people at the site at the beginning of each hour in the designated zone (hourly car counts, hourly people counts).[2] To facilitate counting, we have provided three printable templates (found in Field Data Sheets.docx) and also in Appendix D – one for both continuous and hourly car counts (Figure 8), one for continuous people counts (Figure 9), and one for hourly people counts (Figure 10).

[2] In our Three Bays study, we counted both entries to and exits from the site, in order to calculate the stock in the traditional way (as the difference between cumulative entries and exits at each point in time – Figure 3). In this guide, we have simplified the method to only count entries to a site, using hourly periodic counts to estimate the stock at the beginning of each hour.

For continuous and hourly car counts (using data sheet "Continuous and Hourly Car Counts" – Figure 8; Appendix D), enter:

1. Site name
2. Date
3. Observer name(s)
4. Start time of counting that day
5. Number of vehicles on site within delineated zone at start of counting
6. Number of vehicles that enter the delineated zone during each 30-minute time period
7. Total vehicles on site at the beginning of each hour
8. End time of counting that day

For continuous people counts (using data sheet "Continuous People Counts" - Figure 9; Appendix D), enter:

1. Site name
2. Date
3. Observer name(s)
4. Start time of counting that day
5. Number of people on site within the delineated zone(s) at start of counting
6. Number of people that enter the delineated zone(s) during each 30-minute time period. This may be entered either as a single tally for all activities or as separate tallies for up to 8 activities.

   We suggest assigning each person an activity based on the initial activity observed, since people may engage in multiple activities during a single visit. If counting at multiple sites, use the same set of activities for each site (although some sites may not support every activity). This will allow for a summary by activity. Note that it may be difficult to assign people to activities, either due to the configuration of the site (not being able to see where people go once they enter) or because it is a particularly busy site. You may want to consider other approaches to assigning activities based on your needs and the conditions at your sites.
7. End time of counting that day

For hourly people counts (using data sheet "Hourly People Counts" - Figure 10; Appendix D), enter:

1. Site name
2. Date
3. Observer name(s)
4. Start time of counting that day
5. Number of people on site within the delineated counting zone(s) at start of counting
6. Number of people on site within the delineated counting zone(s) at the beginning of each hour
7. End time of counting that day

The bottom of each worksheet has spaces for entering the name or initials of the person entering the data, the date entered, and the data sheet number. These will be filled in as part of stage 4.

For all three approaches, it can be useful to collect additional data, including site attributes and weather. We have not incorporated this information into the methods presented here, but it can be used in various ways. Qualitatively, data on site attributes and weather can be used to paint a more complete picture of the results. Quantitatively, it might be used in more complex models to predict visitation by day type and weather (see, for example, Lyon et al. 2018). We have included a data sheet for collecting site data ("Site Conditions Data Sheet" in the Field Data Sheets.docx file and also in Appendix D). On this sheet, enter:

1. Site name
2. Date
3. Observer name(s)
4. Site conditions – conditions on shore, including amount of trash and litter and algae (seaweed) on the shore
5. Comments on site conditions, including any signs posted (such as use restrictions, warnings, closures, etc.), and other notable site conditions (such as heavy erosion, difficult access, etc.)
6. Water conditions – assessment of water quality and listed aspects of water quality – check appropriate level for each
7. Comments on water conditions
8. Weather conditions (cloud cover; precipitation; wind speed and direction; other comments)

You may want to modify this sheet to fit the particular data collection needs of your project. For example, there may be other site conditions, such as wave height or shoreline erosion, that would be useful to collect. You also may want to collect data on site amenities (restrooms, etc.) and their condition.

EXAMPLE

Continuous and Hourly Car Counts

Date: 7/20/18

Observer Name(s): J. Doe Site: N.K. Town Beach

Start Count Time: noon **Number of cars at start:** 60 **End Count Time:** 4:00pm

	5:00-5:29 AM	5:30-5:59 AM	Top of hour count 6:00 AM	6:00-6:29 AM	6:30-6:59 AM	Top of hour count 7:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	7:00-7:29 AM	7:30-7:59 AM	Top of hour count 8:00 AM	8:00-8:29 AM	8:30-8:59 AM	Top of hour count 9:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	9:00-9:29 AM	9:30-9:59 AM	Top of hour count 10:00 AM	10:00-10:29 AM	10:30-10:59 AM	Top of hour count 11:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	11:00 - 11:29 AM	11:30 - 11:59 AM	Top of hour count 12:00 PM	12:00 - 12:29 PM	12:30 - 12:59 PM	Top of hour count 1:00 PM
Cars entering zone			# cars within zone:	𝍸 𝍸 𝍸 I	𝍸 𝍸 𝍸 III	# cars within zone: 61

	1:00-1:29 PM	1:30-1:59 PM	Top of hour count 2:00 PM	2:00-2:29 PM	2:30-2:59 PM	Top of hour count 3:00 PM
Cars entering zone	𝍸 𝍸 IIII	𝍸 𝍸 𝍸 III	# cars within zone: 65	𝍸 𝍸 𝍸 IIII	𝍸 𝍸 𝍸 𝍸 III	# cars within zone: 63

Note: Counts for 3:00pm -4:00pm are not illustrated in the example.

Data entered by:_____ Date entered:_____ Data sheet #_____

Figure 8. First Page of continuous and hourly car counts data sheet with example data.

EXAMPLE

Continuous People Counts

Date: 7/20/18

Observer Name(s): J. Doe Site: N.K. Town Beach

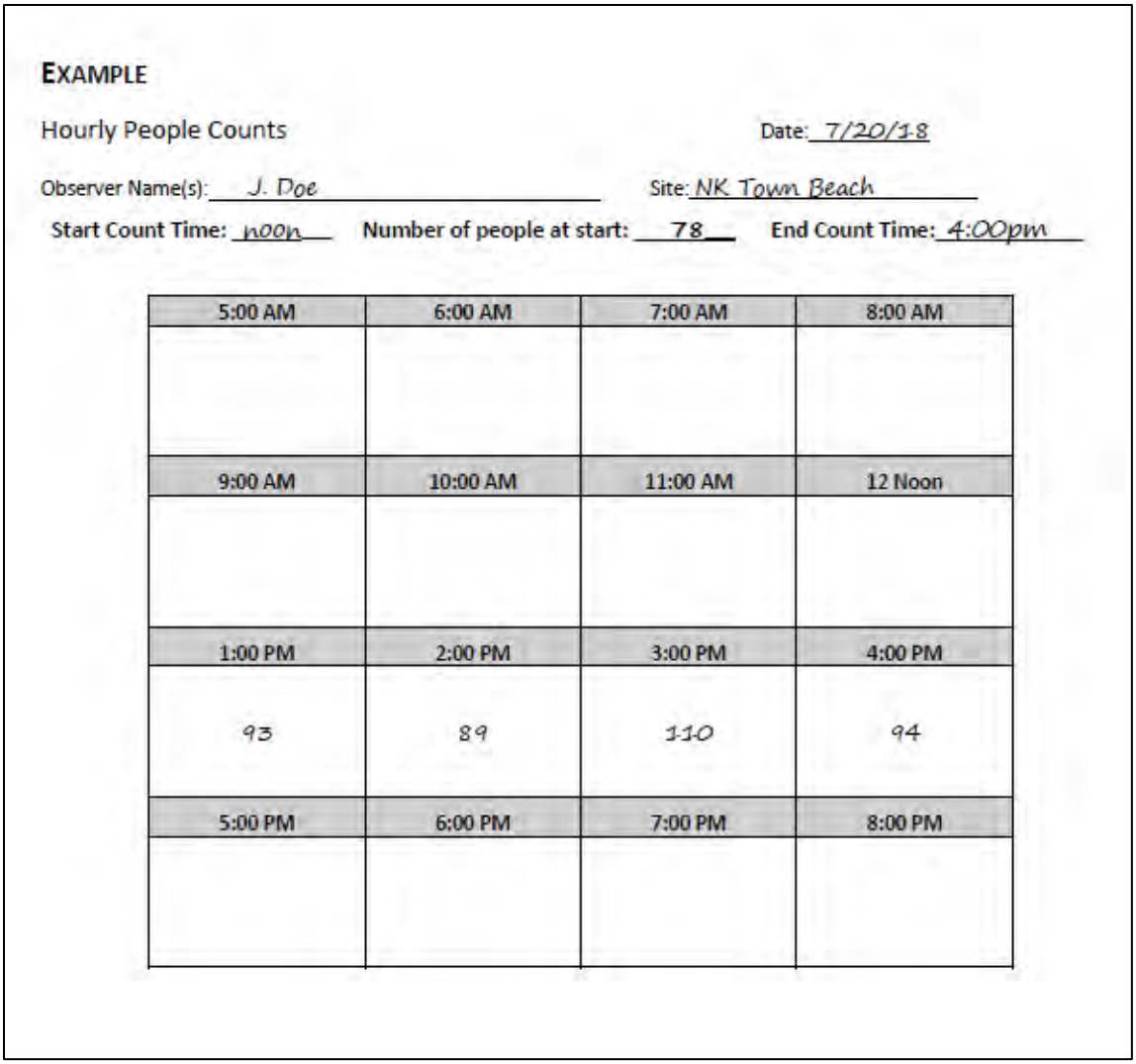
Start Count Time: noon **Number of people at start:** 78 **End Count Time:** 4:00pm

Activity	11:00-11:29 AM	11:30-11:59 AM	12:00-12:29 PM	12:30-12:59 PM	1:00-1:29 PM	1:30-1:59 PM
Chilling			𝍸 𝍸	𝍸 𝍸 III	𝍸 𝍸 I	𝍸 𝍸 II
Kayak/SUP/ Rowing				I		
Fishing from shore						
Fishing from boat						
Boating						
Walk-by						

NOTE: The example shows only a portion of the day.

Data entered by:_____ Date entered:_____ Data sheet #_____

Figure 9. Continuous people counts data sheet with example data.



EXAMPLE

Hourly People Counts Date: 7/20/18

Observer Name(s): J. Doe Site: NK Town Beach

Start Count Time: noon Number of people at start: 78 End Count Time: 4:00pm

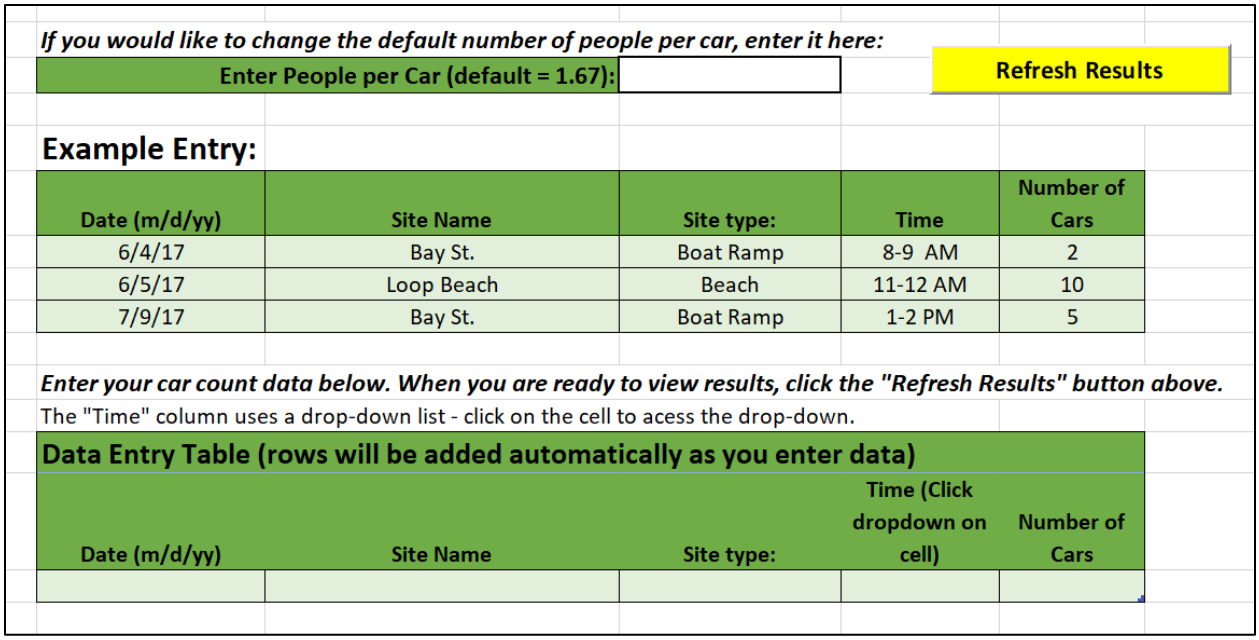
5:00 AM	6:00 AM	7:00 AM	8:00 AM
9:00 AM	10:00 AM	11:00 AM	12 Noon
1:00 PM	2:00 PM	3:00 PM	4:00 PM
93	89	110	94
5:00 PM	6:00 PM	7:00 PM	8:00 PM

Figure 10. Hourly people counts data sheet with example data.

Stage 4. Enter data into excel spreadsheet and perform calculations. We provide Excel spreadsheets with this guide to enter your data, calculate common summaries of that information, and create figures and tables. Table 1 describes all of the provided spreadsheets. We provide both blank spreadsheets and spreadsheets using some of our project data as examples. The spreadsheets contain macros to perform the calculations, and these will need to be enabled for them to function properly. In the event that the macros do not function properly with your hardware or software, you may use our spreadsheets as templates, along with the equations in Appendix C, to create your own sheets customized for your data.

Approach 1 - single periodic count(s) – "Periodic Count data entry.xlsm"

Enter the periodic count(s) into the Excel spreadsheet's "DataEntry" worksheet, following the instructions at the top of the page. The sheet allows you to enter your own value for people per car or use the default of 1.67 people per car. When you click the "Refresh Results" button, the spreadsheet will apply extrapolation factors from Three Bays (Mulvaney et al. 2019) to calculate your estimated visits for the entire day for each day and site counted. Figure 11 shows a screenshot of the blank data entry sheet.



If you would like to change the default number of people per car, enter it here:

Enter People per Car (default = 1.67):

Refresh Results

Example Entry:

Date (m/d/yy)	Site Name	Site type:	Time	Number of Cars
6/4/17	Bay St.	Boat Ramp	8-9 AM	2
6/5/17	Loop Beach	Beach	11-12 AM	10
7/9/17	Bay St.	Boat Ramp	1-2 PM	5

Enter your car count data below. When you are ready to view results, click the "Refresh Results" button above.

The "Time" column uses a drop-down list - click on the cell to acess the drop-down.

Data Entry Table (rows will be added automatically as you enter data)

Date (m/d/yy)	Site Name	Site type:	Time (Click dropdown on cell)	Number of Cars

Figure 11. Screenshot of the excel blank data entry sheet for single periodic counts.

For each periodic count, you will enter:

1. Date of count (m/d/yy)
2. Site name (be sure spelling is consistent for multiple entries at the same site)
3. Site type (e.g., beach, boat ramp, landing, way to water, park, etc. – be sure spelling is consistent for multiple entries for the same site type)
4. Time block of periodic count. These are presented as a dropdown menu of hourlong blocks, from 5:00am to 9:00pm. Click on the cell to access the dropdown menu and click the down arrow to select a time period. If your count was taken on the hour, select the time period starting with that hour (for example, for 1:00 pm, select the 1-2 pm time period).
5. Number of cars observed
6. If you observe that there are more or fewer people per car than our default value of 1.67, enter your value for people per car in the box above the data entry table.

When you are done entering data, click the “Refresh Results” button, located above the data entry table (Figure E-1). The spreadsheet will then calculate estimated visits for each day and location in which a count was taken. The “Results” worksheet provides a printable summary report of the estimates that can be filtered in different ways. An example using the URI Narragansett Bay data is shown in Appendix E. It includes:

- Filters that you can turn on and off to view results by day type (weekday, weekend), day of week, month, site type, and site name (Figure E-2)
- Graphs of average daily visits: total, day type, month, site type, day of week, and site by month (Figures E-3,4)

- An approximate estimate of total seasonal visits (for June, July, and August) for each of the sites included in your counts. This is calculated by multiplying the number of weekdays and weekend days by the relevant average visits per weekday and weekend day, and summing over the season (Figure E-4).
- An estimate of total visits across all sites for the season
- A summary table of the data entered and estimated visits (Figure E-5)

> ***Example**:* During the summer of 2018, researchers from the University of Rhode Island (URI) conducted intercept surveys at 16 coastal access points around Narragansett Bay (Figure 12; RI EPSCoR 2020). While conducting these surveys, they took periodic counts of people and cars at each location, with most locations sampled on more than one day. Using the URI data for 16 sites, with counts taken on one to four days for each site, we entered the car counts into our Periodic Count spreadsheet. The spreadsheet applies our extrapolation factors from the Three Bays study to estimate each site's total daily visits for each day and provides an estimate of seasonal visitation for all sites. Because the URI data indicate a slightly higher number of people per car, we adjusted the extrapolation factors to use this number when generating the visitation estimates. Screenshots of the data entry and results are included in Appendix E, and the spreadsheet is available along with this report.

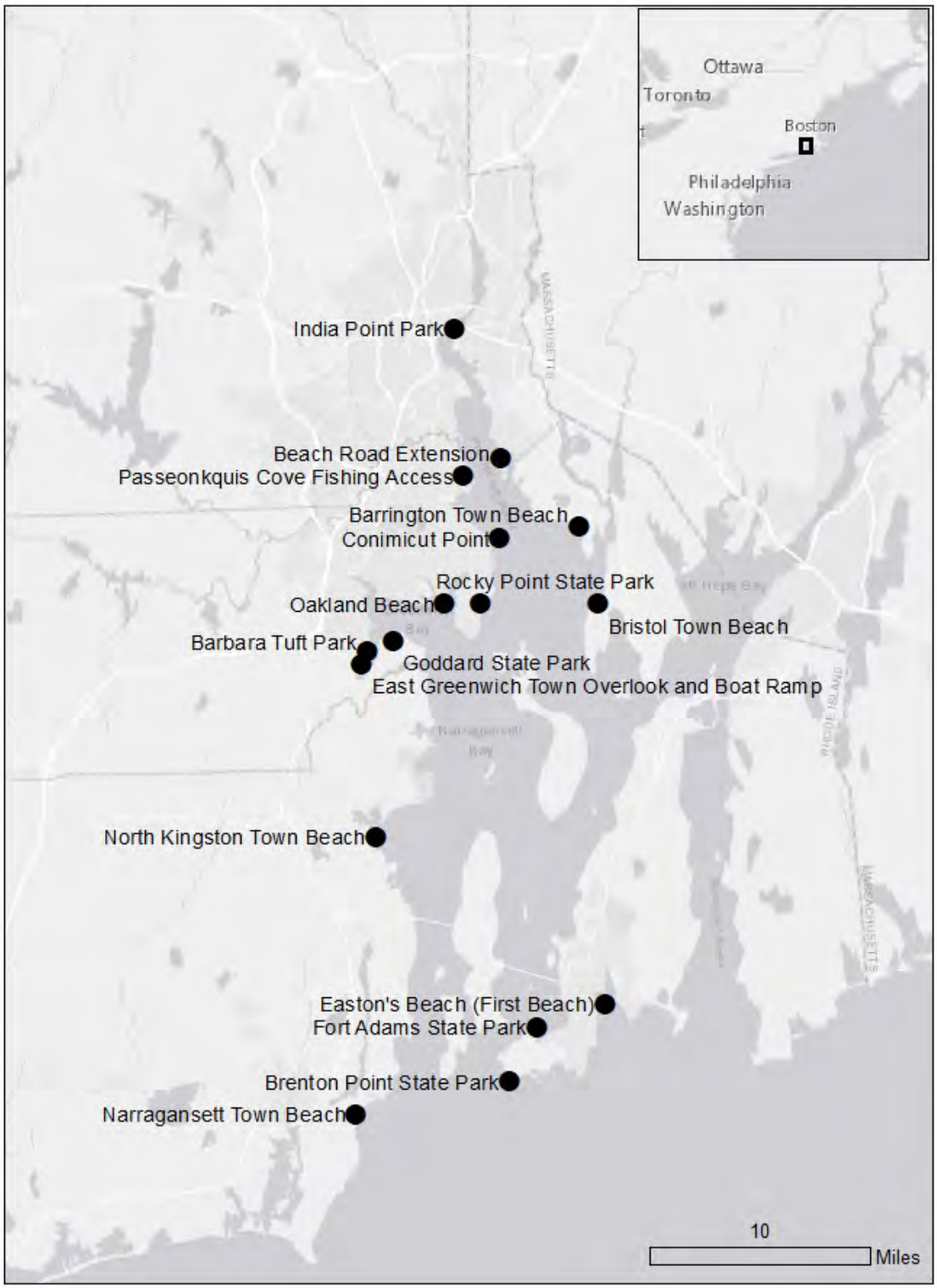


Figure 12. Map of Narragansett Bay and the 16 public access points included in the University of Rhode Island Study.

Approaches 2 and 3 - Four-hour or all-day continuous count plus periodic count(s):

"Continuous Count data entry.xlsm"

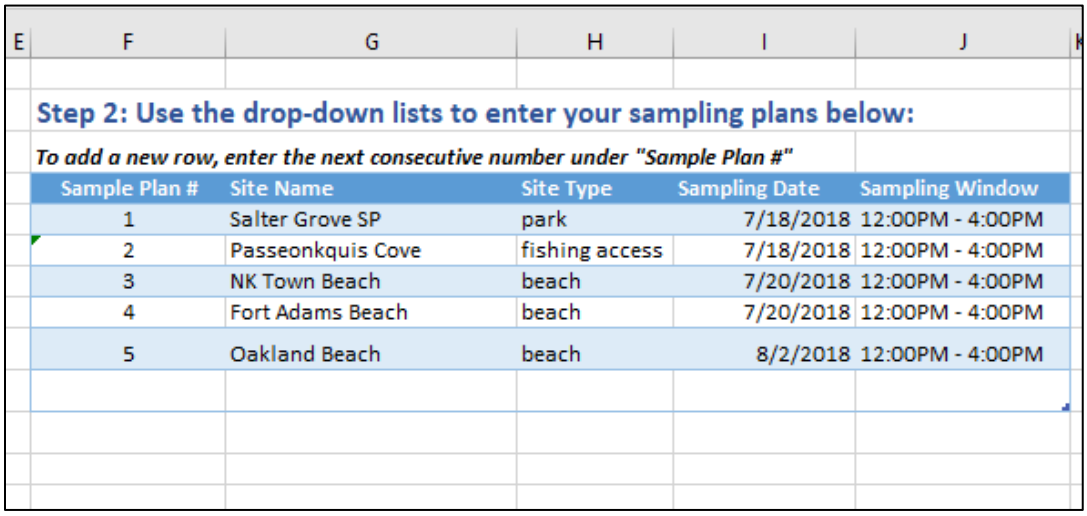
Begin by entering your sampling plan in the "SamplingPlan" worksheet. This will populate the data entry sheets with the required number of spaces.
First, in the "Step 1" section of the sheet (Figure 13), you will enter:

1. Site types (up to 6)
2. Activities monitored, if you would like to count by activity (up to 8); if not, simply enter a single activity name, such as "all"
3. Site names
4. Sampling dates (m/d/yy)

	A	B	C	D
3				
4		**Step 1: Start by entering parameters for sampling below:**		
5		**Enter distinct types of sites:**		**Enter dates that sampling occurs:**
6		Site Types (up to 6)		Sampling Dates (m/d/y)
7		park		7/18/2018
8		fishing access		7/20/2018
9		beach		8/2/2018
10				
11				
12				
13				
14		**Enter activities monitored:**		
15		Activities (up to 8)		
16		chilling		
17		kayak/SUP/rowing		
18		other boating		
19		fishing from shore		
20		fishing from boat		
21		walk-by		
22		other		
23				
24				
25		**Enter site names:**		
26		Site Names		
27		Salter Grove SP		
28		Passeonkquis Cove		
29		NK Town Beach		
30		Fort Adams Beach		
31		Oakland Beach		
32				
33				
34				
35				
36				
37				
38				

Figure 13. Sampling plan entry sheet showing Narragansett Bay example.

Next, scroll to the right to the "Step 2" section (Figure 14), and use the dropdown menus to populate each individual sampling plan (combination of site and date). These dropdowns will be populated with the data entered in Step 1.



Step 2: Use the drop-down lists to enter your sampling plans below:

To add a new row, enter the next consecutive number under "Sample Plan #"

Sample Plan #	Site Name	Site Type	Sampling Date	Sampling Window
1	Salter Grove SP	park	7/18/2018	12:00PM - 4:00PM
2	Passeonkquis Cove	fishing access	7/18/2018	12:00PM - 4:00PM
3	NK Town Beach	beach	7/20/2018	12:00PM - 4:00PM
4	Fort Adams Beach	beach	7/20/2018	12:00PM - 4:00PM
5	Oakland Beach	beach	8/2/2018	12:00PM - 4:00PM

Figure 14. Sampling plans table, showing Narragansett Bay example.

Finally, scroll to the right again to Step 3 (Figure 15), and click the "Generate Entry Forms" box to generate the data entry sheets for your sampling plan.

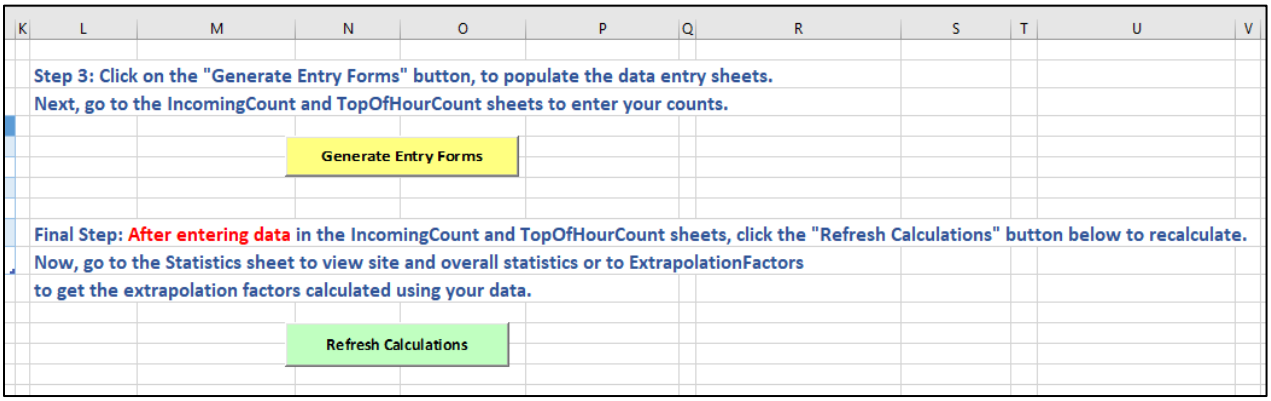


Figure 15. Buttons to generate data entry forms and to refresh calculations.

Next, in the "IncomingCount" sheet, enter the starting count of people (by activity or just the total) and cars (total), as well as the counts for each 30-minute time period during your sampling window.

In the "TopOfHourCount" sheet, enter the hourly counts of people and cars for each site for your sampling window.

The "Statistics" page summarizes results and the "ExtrapolationFactors" page calculates your custom hourly extrapolation factors from your counts. These extrapolation factors can then be substituted for our default factors to use to estimate daily visits from periodic counts in your area.

Example: During the summer of 2018, we conducted four-hour counts (12:00pm to 4:00pm) at five sites around Narragansett Bay, on one day for each site. These five sites are a subset of the 16 locations used in the URI periodic count study described above. We entered these counts into our Continuous Count spreadsheet and calculated new extrapolation factors. Compared to the Three Bays factors, our Narragansett Bay factors are about 1.5 times larger. This is due to generally faster turnover of people and cars at the locations included (people didn't tend to stay as long, which means each person counted will translate to more visitors per day). However, the rates of turnover vary across sites, and our sample of sites and days is very small for Approach 2 in Narragansett Bay, so we present this example as an illustration only. While the higher turnover may legitimately increase the extrapolation factors, we do not consider the results to be sufficiently accurate to draw conclusion because of the small sample of locations and days. Therefore, we recommend using a larger sample of sites and days when applying Approach 2. These results are included in Appendix F, and the spreadsheet is available with this report.

IV. HOW TO ESTIMATE AND APPLY A VALUE PER DAY FOR BEACH VISITS

As we discussed at the outset, understanding the aggregate non-market value of coastal recreation requires estimating both the number of people affected and the value per person. The bulk of this report has focused on estimating the number of people – visitation. This section describes how to calculate the non-market value of a beach visit for your location based on estimates from a meta-analysis model that we developed (Lyon et al. 2018). The model included values from 25 studies, obtained from the Recreation Use Values Database (RUVD), a database of studies of recreational values (Rosenberger 2016). *Consumer surplus* values—the measure of people's willingness to pay above and beyond what they actually pay—are presented as value per day in 2016 dollars. The study locations include both freshwater and saltwater beaches. In addition to variables included in the RUVD for study characteristics, location characteristics, and visitor characteristics, we added two variables obtained from other sources. Variables for length of beach and whether the beach was closed at all during the previous five years (2011-2015; U.S. Census Bureau, U.S. EPA BEACON database) serve as indicators of beach quality and water quality.

This model can only be used for beach visits (for example, trips to the shoreline for swimming/wading, playing on the sand, walks on the beach, and more). We did not estimate values for other types of coastal recreation (recreational fishing, boating, birding, etc.), though there are models available to obtain values per day for various types of recreation in the Benefit Transfer Toolkit, available at https://sciencebase.usgs.gov/benefit-transfer/. On this site, you can find information on economic values for many types of outdoor recreation. It includes databases of existing valuation estimates, a map of study locations for recreational values, a set of statistical models for estimating values for several types of outdoor recreation, average values by region for many types of outdoor recreation, and other related information.

The model can be used to predict the value of a beach visit for a location by applying the policy-relevant parameters for that location to the model results (*benefit transfer*; Johnston et al. 2015, Richardson et al. 2015, Wilson and Hoehn 2006).

This model is included in the Excel spreadsheet "WTP tool for beaches.xlsx" that accompanies this report. It included default values for the model parameters based on averages from the studies included in the meta-analysis. If you have information specific to your location, you may enter the following beach and trip parameters:

- Saltwater or freshwater beach
- Region of the United States
- Whether you want to value day trips or overnight trips
- The percent of visitors who are residents versus non-residents/visitors
- Beach length in miles
- Whether the beach has been closed due to water quality issues in the past five years
- The daily parking/entrance fees per person if you would like to include impacts of lost revenues when evaluating beach closures

Once you enter the parameters, the spreadsheet will calculate a value per person per day in 2016 dollars.

> ***Example:*** In Lyon et al. (2018), we used the meta-analysis model to estimate consumer surplus per day of a saltwater beach visit for a New England beach that has experienced closures in the past five years as $21.99. A beach visit to a New England beach without a history of closures is worth $47.58 per person per day, indicating a large value to people for beaches without closures.

The value per person per day may then be applied to the number of visitors to get an aggregate value per day for a site. This is calculated in the spreadsheet, along with a lost use value for a beach closure day. The lost value due to closure assumes that 67 percent fewer people go to the beach when there is a swimming advisory (based on Lyon et al. 2018). The user can change this assumption in the tool based on local behavior, if known. The total lost value due to a closure includes the loss of revenue for parking fees (if entered) as well as lost consumer surplus for that day (see Lyon et al. 2018 for more details).

Beyond parking revenues, beaches provide other market values in the form of money spent by visitors in the local economy in conjunction with their beach visit. We do not provide methods for estimating these market values, beyond the parking fees collected. NOAA has reports, tutorials and guides to collecting market values (see https://coast.noaa.gov/digitalcoast/topics/economy.html for NOAA's resources.)

V. CONCLUSIONS AND CAVEATS – HOW TO USE YOUR RESULTS

In this report, we presented three approaches to estimate visitation to coastal access sites, using observations of visitors—single periodic counts, or periodic counts combined with four-hour or all-day continuous counts. We also presented a tool to estimate the dollar value (consumer surplus) of a beach day based on a meta-analysis of existing values from the literature.

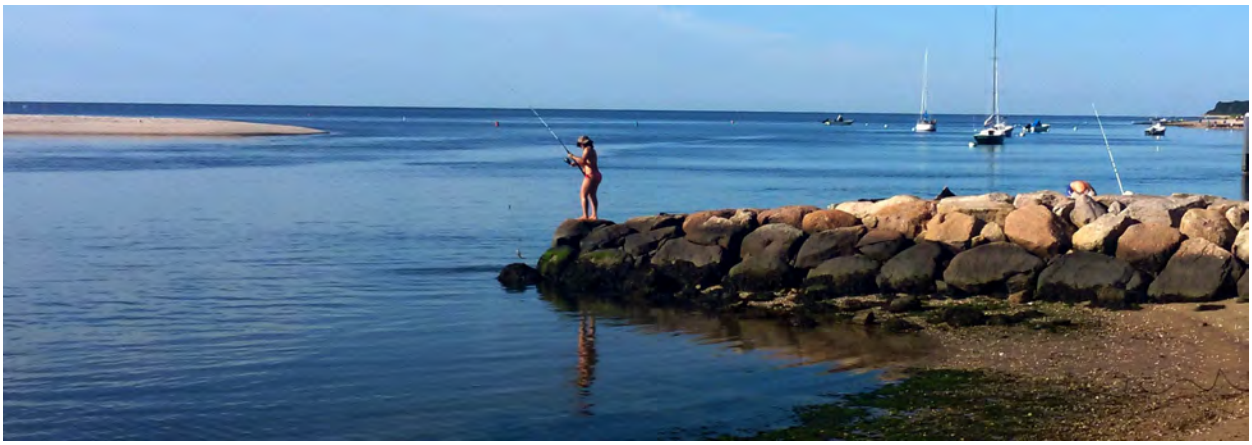
Inaccuracy in estimating visitation is a limitation of all approaches commonly used for this purpose (King and McGregor 2012, Wallmo 2003), including ours. We designed our processes to be, at a minimum, unbiased, meaning not consistently over- or under-counting the visitation metric of interest. We validated the more complicated approach (Approach 3) described here in our Three Bays study against counts we took all day. In that study, we applied our extrapolation factors created over seven days of sampling for 11 sites (Approach 3) to periodic counts taken for those same sites and days (Approach 1) and compared the predicted visitation to the actual all-day counts. We found that our estimates had low bias and a mean absolute percent error of 44% and a root-mean-squared error of 14.4 people per site per day. This means that estimates using our extrapolation factors applied to single periodic counts were, on average, 44% above or below the true total visitation for the day. The accuracy in terms of number of people estimated as compared to actual counts depends on the size of the site. We have no data related to nighttime visitation, and therefore have not provided approaches for estimating nighttime visitation in this report, though the approaches presented here can be replicated for sites where nighttime use is important.

For future application of our methods, the exact accuracy would be known only with a complementary validation study of the type presented in Mulvaney et al. (2019), which is beyond the scope of most practical applications. We highlight the accuracy of our application to be transparent about the level of uncertainty in estimates derived from our methods. Visitation estimates from any method show considerable uncertainty but provide valuable and otherwise unknown information on visitation to water access sites and estuaries in general. For most applications, the accuracy is sufficient given the alternative is no information on visitation at all.

These methods of estimating visitation allow the user to better understand the scale of recreational use of individual sites and of entire estuaries. This information is often missing when assessing the potential beneficiaries of environmental protection (or potential losers to environmental degradation). For example, our Three Bays work found that, although sites within the estuary were small, in total they represented about the same scale of visitation as a nearby major town beach. The ongoing efforts on Cape Cod to improve estuary water quality affect a significant number of people that were until recently uncounted.

While our study was aimed at understanding the value of coastal access to the public and highlighting how many people benefit from programs to provide access and protect environmental quality at access points, resource managers can use visitation information in many other ways. Visitation estimates are essential for economic valuation of water quality and other environmental amenities using benefit transfer and are typically the most critical missing piece in these studies. They may serve as a baseline for future natural resource damage assessments, such as those baselines that were missing before the Deepwater Horizon incident (Tourangeau et al. 2017, Horsch et al. 2017); or for smaller discrete events, such as closures resulting from pollution or other events. They can help to assess current and future infrastructure and staffing needs, provide information on patterns and types of use in different locations, indicate where adding or improving access may be most beneficial, inform environmental justice efforts by highlighting the locations and use of access points in proximity to underserved communities, or inspire public engagement in protecting or improving access points and their surrounding areas.

While collecting good data for a specific application is helpful, having visitor use estimates taken and recorded in a similar fashion over many locations would improve larger scale studies of natural resource use. Parks and other inland natural attractions have created systems for estimating visitor totals. This report provides a practical way for estuary and coastal areas to begin to be included in our understanding of the scale of use and value for natural areas.



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APPENDIX A - EXTRAPOLATION FACTORS FROM THREE BAYS, BARNSTABLE, MA

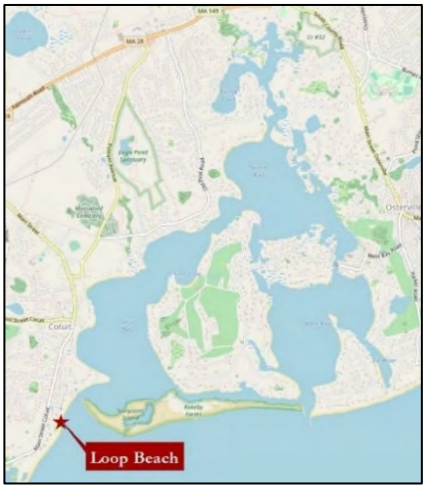
Time Period	Extrapolation Factor
5:00 am – 6:00 am	23.35
6:00 am – 7:00 am	21.90
7:00 am - 8:00 am	19.81
8:00 am – 9:00 am	16.19
9:00 am – 10:00 am	13.16
10:00 am – 11:00 am	9.02
11:00 am – 12:00 pm	8.96
12:00 pm – 1:00 pm	7.68
1:00 pm – 2:00 pm	6.80
2:00 pm – 3:00 pm	6.19
3:00 pm – 4:00 pm	6.31
4:00 pm – 5:00 pm	6.39
5:00 pm – 6:00 pm	7.09
6:00 pm – 7:00 pm	7.50
7:00 pm – 8:00 pm	7.54
8:00 pm – 9:00 pm	7.54

APPENDIX B - COUNTING ZONE MAP EXAMPLES

We defined zones to delineate the recreational use area and parking area(s) of each site. The descriptions and aerial images for the sampled access points were established prior to counting people or cars. Establishing these designated zones beforehand makes it easy to determine when a vehicle or person should be considered as using the public access point rather than determining use based on observed behavior alone. These zones are especially important when the site is busy, such as at a larger beach. The defined zones also allow for greater consistency across observers because the site is sampled the same way each time. To make these for your area, use screenshots taken from mapping software with satellite images and overlay lines to mark zones that indicate where to include a car or person in your counts.

Example #1

Loop Beach, Barnstable, MA



Counting people:

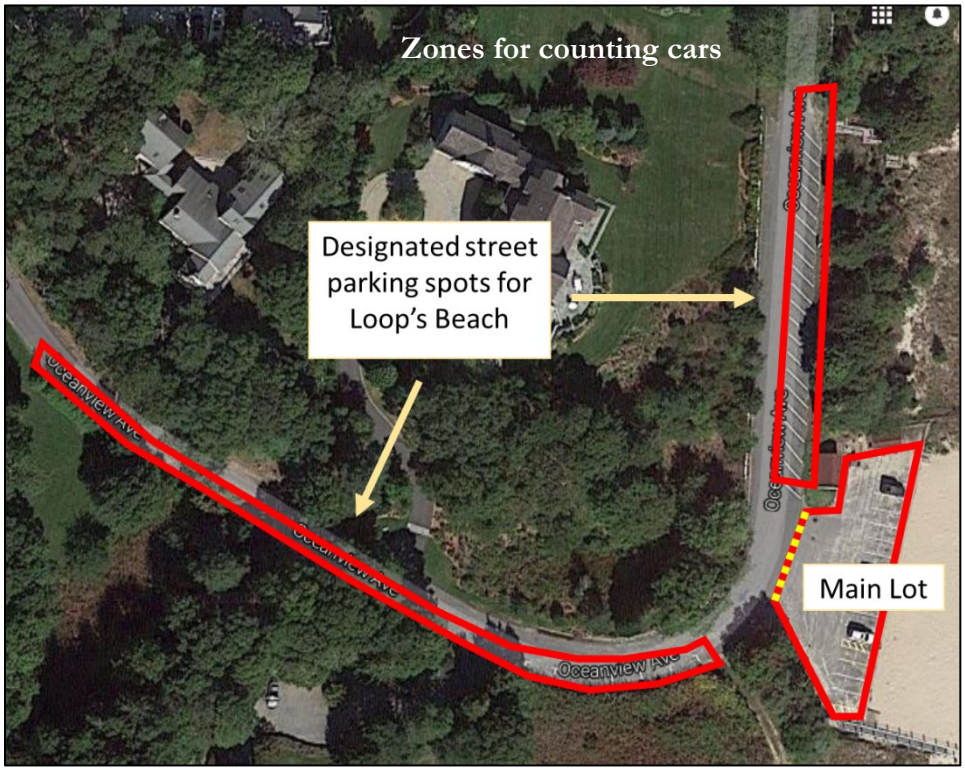
For a **continuous count**, record all the people entering and leaving the beach by crossing the yellow-dotted line. After observing people at this access point, we found that some people would walk onto the beach from private property or access the beach from the water. To clearly define recreational users of Loop Beach, any people who did not cross the yellow-dotted line to get to the beach were not included in the continuous count.

For a **periodic count**, include all people within the red line. This includes people in the parking lot, on the beach, and in the water directly in front of the beach.

Counting cars:

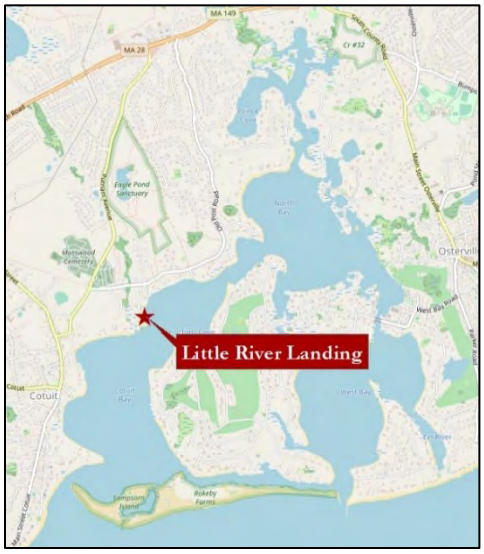
For a **continuous count**, include any cars that enter the main lot closest to the beach or park in a designated space along the street. Arrivals are counted when either parked in a space or entering the main lot by crossing the yellow-dotted line. Departures are counted when the parked cars along the street leave or a vehicle exits the main lot by crossing the yellow-dotted line.

For a **periodic count**, record all cars parked in designated parking spots along Oceanview Avenue. Also count all cars in the main parking lot (these cars in the main lot do not need to be parked in a designated spot).



Example #2

Little River Landing, Barnstable, MA



Counting people:

For a **continuous count**, record all the people entering and leaving the site by crossing the yellow-dotted line. Because Little River Landing is at the end of the road, we observed many people walking to the end of the road, turning around, and going back. These people are still included in the count, which is why the demarcated yellow-dotted line is at the beginning of the road and not where the road ends.

For a **periodic count**, include all people within the red line. For this access point, we excluded people working on the oyster farm seen in the water just outside of the red line.

Counting cars:

For a **continuous count**, record all cars that enter or exit the zone by crossing the yellow-dotted line.

For a **periodic count**, record all cars in the designated zone on Belair Lane.

APPENDIX C - CALCULATIONS

Continuous counts

Total visits for a site on a particular day are the sum of an initial count plus the sum of people counted entering (or exiting) the site for the day:

$$V_d^i = J_0 + \sum_{t=0}^{T} J_t$$

Where,

V_d^i – total number of recreational users from all-day counts for sites i on day d

J_0 – the initial count of visitors upon arrival at the site

J_t – the count of recreational users entering at time t

and the hours of counting range from the starting time (t=0) to the ending time (t=T).

Counts of people may be separated by activity or summed over all activities. We determined activity by the initial activity each person was observed to be doing.

Similarly, total cars entering the designated site parking area would be summed over the hours of counting.

For ease of keeping track of counts, tally the counts of both people and cars entering in 30-minute intervals. We provide templates for counting people and cars in 30-minute increments.

Estimate **people per car** by dividing the total number of visitors by total cars for the day.

Periodic counts

At the beginning of each hour, count total people and cars at the site.

C_{td}^i – the periodic count (of people or cars) at site i, for time t and day d

Extrapolation factors

First, for each site, day, and hour, calculate the inverse of the extrapolation factor, which is an estimate of the probability of a person or car being counted at a particular time. This initial step is done in order to avoid issues with times where the periodic count may be zero. This is calculated as:

$$P_{td}^i = \frac{C_{td}^i}{V_d^i}$$

Next, calculate an average extrapolation factor for each hour by taking the inverse and average of all of these estimates:

$$E_t = \frac{1}{\frac{1}{n_t} \sum \frac{C_{td}^i}{V_d^i}}$$

Where,

E_t – the extrapolation factor for hour t
n_t – the number of observations made in hour t across all sites and days
V_d^i – total number of recreational users from all-day counts for sites i on days d
C_{td}^i – periodic count of cars or people for sites i on days d in hour t

To estimate the total visits for a full day using a periodic count, multiply the periodic count by the extrapolation factor for the hour that the count was taken:

$$\widehat{V_d^i} = E_t * C_{td}^i$$

Where,

$\widehat{V_d^i}$ – estimated total recreational visitors for day d at site i

Estimating total visits per day when counting from 9:00am – 4:00pm or from 12:00pm – 4:00pm

In our study of Three Bays, Cape Cod, Massachusetts, we counted from sunrise to sunset for some days and sites, and from 9:00am to 4:00pm for some days and sites. From our all-day counts, we estimated that counts from 9:00am to 4:00pm captured 60.45% of total cars for the day and 59.93% of total people for the day; and counts from 12:00pm to 4:00pm captured 37.22% of total cars and 32.71% of total people.

If you do not count from sunrise to sunset, you can use these percentages to adjust your shorter counts to reflect the entire day, by dividing your estimate by the appropriate percentage listed above. For example, if you count 100 people between 9:00am and 4:00pm, divide by .5993 to estimate a total of 167 people for the day. Similarly, if you count 100 people between 12:00pm and 4:00pm, divide by .3271 to estimate a total of 306 people for the day.

Estimates of visits per month and season

A rough estimate of total visitors for the season per site can be calculated as a weighted average of weekend and weekday visitors. The accuracy of this estimate will increase as the number of days counted increases. In the periodic count spreadsheet, we provide the simplest estimate:

$$S = wd * V_{wd} + we * V_{we}$$

Where,
S – Seasonal visitation for a site
wd - # of weekdays in season
we- # of weekend days and holidays in season
V_{wd}- average count of visitors to the site on a weekday
V_{we} - average count of visitors to the site on a weekend day or holiday

The spreadsheet will average total seasonal visits per site over all sites. To get a total for an estuary, you will need to multiply this average by the number of sites in the estuary.

APPENDIX D - DATA SHEETS

The data sheets for counting and site conditions are included in this appendix.

Periodic Car Counts Data Sheet

This document accompanies the EPA report: *How to Quantify Coastal Recreation in an Estuary: Methods for Estimating the Number of Participants and Value of Recreation for Coastal Access Points*. See the report for more details on applying the methods.

Use these sheets to record periodic vehicle counts at your selected site(s).

Instructions for Periodic Car Counts:

Print out the data sheets you will need for your purposes (based on number of sites, days, and people counting).

At each site, count the number of vehicles within your delineated parking zone(s). To improve accuracy of applying extrapolation factors, it is generally best to count during the hours of 12:00 pm to 4:00 pm, since at many sites peak visitation occurs during these hours. For sites where visits peak at different times of day, see the report for suggestions.

On the data sheet, first enter observer name(s).

Then, for each count, enter:

1) Site name and type (for example, beach, boat ramp, landing, park, fishing access, wharf, way to water)
2) Date of count
3) Time of count
4) Number of vehicles counted within the designated zone(s)
5) Whether the lot is full (this is not used in the calculations, but can be useful information to determine capacity of a site)
6) Additional comments (for example, unusual events or conditions at the site)

The bottom of each sheet has spaces for entering the name or initials of the person entering the data, the date entered, and the data sheet number. These will be filled in when you enter the data.

The next page is an example.

EXAMPLE: Periodic Car Counts

Observer Name(s) J. Doe

Site Name and Site Type		Date	Time	# Cars	Lot Full?	Additional Comments
Name	E. Greenwich	7/25/18	1:00 pm	7	Yes / (No)	
Type	Boat ramp					
Name	Oakland Beach	7/25/18	2:00 pm	30	Yes / (No)	windy
Type	Beach					
Name	B. Tuft Park	8/14/18	1:00 pm	8	Yes / (No)	
Type	Park					
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						

Data entered by: Date entered: _____ Data sheet #_____

Periodic Car Counts

Observer Name(s) _____

Site Name and Site Type		Date	Time	# Cars	Lot Full?	Additional Comments
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						

Data entered by: _____ Date entered: _____ Data sheet #_____

Periodic Car Counts

Observer Name(s) _____

Site Name and Site Type		Date	Time	# Cars	Lot Full?	Additional Comments
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						
Name					Yes / No	
Type						

Data entered by: Date entered: _____ Data sheet #_____

Continuous and Hourly Car Counts Data Sheet

This document accompanies the EPA report: *How to Quantify Coastal Recreation in an Estuary: Methods for Estimating the Number of Participants and Value of Recreation for Coastal Access Points*. See the report for more details on applying the methods.

Use these sheets to record continuous and "top of hour" vehicle counts at your selected site(s).

Instructions for Continuous and Hourly Car Counts:

Print out the sheets you will need for your purposes (based on number of sites, days, and people counting).

On the data sheet, enter:

1) Site name
2) Date
3) Observer name(s)
4) Start time of counting that day
5) Number of vehicles on site within delineated zone at start of counting
6) Number of vehicles that enter the delineated zone during each 30-minute time period
7) Total vehicles on site at the beginning of each hour
8) End time of counting that day

Instructions for entering numbers of vehicles: Tally the number of vehicles entering the designated zone for each 30-minute time period. To tally,  indicates 5 vehicles. At the beginning of each hour, count the total vehicles within the counting zone, and enter in the "top of hour count" box. There are enough boxes to count continuously for any time period from 5am to 8pm.

The next page gives an example.

EXAMPLE

Continuous and Hourly Car Counts

Date: 7/20/18

Observer Name(s): J. Doe Site: N.K. Town Beach

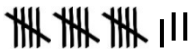
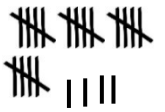
Start Count Time: noon **Number of cars at start:** 60 **End Count Time:** 4:00pm

	5:00-5:29 AM	5:30-5:59 AM	Top of hour count 6:00 AM	6:00-6:29 AM	6:30-6:59 AM	Top of hour count 7:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	7:00-7:29 AM	7:30-7:59 AM	Top of hour count 8:00 AM	8:00-8:29 AM	8:30-8:59 AM	Top of hour count 9:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	9:00-9:29 AM	9:30-9:59 AM	Top of hour count 10:00 AM	10:00-10:29 AM	10:30-10:59 AM	Top of hour count 11:00 AM
Cars entering zone			# cars within zone:			# cars within zone:

	11:00 - 11:29 AM	11:30 - 11:59 AM	Top of hour count 12:00 PM	12:00 - 12:29 PM	12:30 - 12:59 PM	Top of hour count 1:00 PM
Cars entering zone			# cars within zone:			# cars within zone: 61

	1:00-1:29 PM	1:30-1:59 PM	Top of hour count 2:00 PM	2:00-2:29 PM	2:30-2:59 PM	Top of hour count 3:00 PM
Cars entering zone			# cars within zone: 65			# cars within zone: 63

Note: Counts for 3:00pm -4:00pm are not illustrated in the example.

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous and Hourly Car Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of cars at start: _____ End Count Time:_____

	5:00-5:29 AM	**5:30-5:59 AM**	**Top of hour count 6:00 AM**	**6:00-6:29 AM**	**6:30-6:59 AM**	**Top of hour count 7:00 AM**
Cars entering zone			# cars within zone:			# cars within zone:

	7:00-7:29 AM	**7:30-7:59 AM**	**Top of hour count 8:00 AM**	**8:00-8:29 AM**	**8:30-8:59 AM**	**Top of hour count 9:00 AM**
Cars entering zone			# cars within zone:			# cars within zone:

	9:00-9:29 AM	**9:30-9:59 AM**	**Top of hour count 10:00 AM**	**10:00-10:29 AM**	**10:30-10:59 AM**	**Top of hour count 11:00 AM**
Cars entering zone			# cars within zone:			# cars within zone:

	11:00 - 11:29 AM	**11:30 - 11:59 AM**	**Top of hour count 12:00 PM**	**12:00 - 12:29 PM**	**12:30 - 12:59 PM**	**Top of hour count 1:00 PM**
Cars entering zone			# cars within zone:			# cars within zone:

	1:00-1:29 PM	**1:30-1:59 PM**	**Top of hour count 2:00 PM**	**2:00-2:29 PM**	**2:30-2:59 PM**	**Top of hour count 3:00 PM**
Cars entering zone			# cars within zone:			# cars within zone:

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous and Hourly Car Counts Date:_____

Observer Name(s):_____ Site:_____

	3:00-3:29 PM	3:30-3:59 PM	Top of hour count 4:00 PM	4:00-4:29 PM	4:30-4:59 PM	Top of hour count 5:00 PM
Cars entering zone			# cars within zone:			# cars within zone:

	5:00-5:29 PM	5:30-5:59 PM	Top of hour count 6:00 PM	6:00-6:29 PM	6:30-6:59 PM	Top of hour count 7:00 PM
Cars entering zone			# cars within zone:			# cars within zone:

	7:00-7:29 PM	7:30-7:59 PM	Top of hour count 8:00 PM
Cars entering zone			# cars within zone:

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Data Sheet

This document accompanies the EPA report: *How to Quantify Coastal Recreation in an Estuary: Methods for Estimating the Number of Participants and Value of Recreation for Coastal Access Points*. See the report for more details on applying the methods.

Use these sheets to record continuous people counts at your selected site(s). They are to be used along with the Hourly People Counts sheets.

Instructions for Continuous People Counts:

Print out the pages you need, based on the hours of the day when you will be counting – one set of pages for each site.

At each site, you will be counting the number of people entering your delineated counting zone(s).

On the worksheet, enter:

1) Site name
2) Date
3) Observer name(s)
4) Start time of counting that day
5) Number of people on site within delineated zone(s) at start of counting
6) Number of people that enter the delineated zone(s) during each 30-minute time period – either as a single tally or separate tallies by activity (you must select one activity per person - we recommend using the initial activity observed for each person)
7) End time of counting that day

The bottom of each sheet has spaces for entering the name or initials of the person entering the data, the date entered, and the data sheet number. These will be filled in when you enter the data.

Instructions for entering numbers of people: Tally the number of people entering the designated zone(s) for each 30-minute time period. To tally,  indicates 5 people. At the beginning of each hour, fill in the Hourly People Count sheet. There are enough boxes to count continuously for any time period from 5am to 8pm.

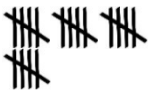
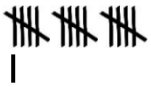
The next page gives an example.

EXAMPLE

Continuous People Counts Date: 7/20/18

Observer Name(s): J. Doe Site: N.K. Town Beach

Start Count Time: noon **Number of people at start:** 78 **End Count Time:** 4:00pm

Activity	11:00-11:29 AM	11:30-11:59 AM	12:00-12:29 PM	12:30-12:59 PM	1:00-1:29 PM	1:30-1:59 PM
Chilling						
Kayak/SUP/ Rowing				I		
Fishing from shore						
Fishing from boat						
Boating						
Walk-by						

NOTE: The example shows only a portion of the day.

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of people at start:_____ End Count Time:_____

Activity	5:00-5:29 AM	5:30-5:59 AM	6:00-6:29 AM	6:30-6:59 AM	7:00-7:29 AM	7:30-7:59 AM

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of people at start: _____ End Count Time:_____

Activity	8:00-8:29 AM	8:30-8:59 AM	9:00-9:29 AM	9:30-9:59 AM	10:00-10:29 AM	10:30-10:59 AM

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of people at start: _____ End Count Time:_____

Activity	11:00-11:29 AM	11:30-11:59 AM	12:00-12:29 PM	12:30-12:59 PM	1:00-1:29 PM	1:30-1:59 PM

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of people at start: _____ End Count Time:_____

Activity	2:00-2:29 PM	2:30-2:59 PM	3:00-3:29 PM	3:30-3:59 PM	4:00-4:29 PM	4:30-4:59 PM

Data entered by:_____ Date entered:_____ Data sheet #_____

Continuous People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time: _____ Number of people at start: _____ End Count Time:_____

Activity	5:00-5:29 PM	5:30-5:59 PM	6:00-6:29 PM	6:30-6:59 PM	7:00-7:29 PM	7:30-8:00 PM

Data entered by:_____ Date entered:_____ Data sheet #_____

Hourly People Counts Data Sheet

This document accompanies the EPA report: *How to Quantify Coastal Recreation in an Estuary: Methods for Estimating the Number of Participants and Value of Recreation for Coastal Access Points*. See the report for more details on applying the methods.

Use these sheets to record hourly people counts at your selected site(s). They are to be used along with the Continuous People Counts sheets.

Instructions for Hourly People Counts:

Print out the pages you need, based on the hours of the day when you will be counting – one set of pages for each site.

At each site, you will be counting the number of people entering your delineated counting zone(s).

On the worksheet, enter:

1) Site name
2) Date
3) Observer name(s)
4) Start time of counting that day
5) Number of people on site within the delineated counting zone(s) at start of counting
6) Number of people on site within the delineated counting zone(s) at the beginning of each hour
7) End time of counting that day

The bottom of each sheet has spaces for entering the name or initials of the person entering the data, the date entered, and the data sheet number. These will be filled in when you enter the data.

Instructions for entering numbers of people: Count and enter the number of people within the designated zone(s) at the beginning of each hour. This sheet is to be filled out in conjunction with the Continuous People Count sheet for each counting day at each site. There are enough boxes to count continuously for any time period from 5am to 8pm.

The next page gives an example.

EXAMPLE

Hourly People Counts

Date: 7/20/18

Observer Name(s): J. Doe

Site: NK Town Beach

Start Count Time: noon **Number of people at start:** 78 **End Count Time:** 4:00pm

5:00 AM	6:00 AM	7:00 AM	8:00 AM
9:00 AM	**10:00 AM**	**11:00 AM**	**12 Noon**
1:00 PM	**2:00 PM**	**3:00 PM**	**4:00 PM**
93	89	110	94
5:00 PM	**6:00 PM**	**7:00 PM**	**8:00 PM**

Data entered by:_____ Date entered:_____ Data sheet #_____

Hourly People Counts Date:_____

Observer Name(s):_____ Site:_____

Start Count Time:_____ Number of cars at start: _____ End Count Time:_____

5:00 AM	6:00 AM	7:00 AM	8:00 AM
9:00 AM	**10:00 AM**	**11:00 AM**	**12 Noon**
1:00 PM	**2:00 PM**	**3:00 PM**	**4:00 PM**
5:00 PM	**6:00 PM**	**7:00 PM**	**8:00 PM**

Data entered by:_____ Date entered:_____ Data sheet #_____

Site Conditions Data Sheet

This document accompanies the EPA report: *How to Quantify Coastal Recreation in an Estuary: Methods for estimating the number of participants and value of recreation for coastal access points*. See the report for more details on applying the methods.

Use these sheets to record conditions at your selected site(s).

Instructions for entering Site Conditions:

Print out the 2-page sheet for each site and day of sampling. At each site, you will be entering conditions for a single day.

On the worksheet, enter:

1) Site name
2) Date
3) Observer name(s)
4) Site conditions – conditions on shore, including amount of trash and litter and algae (seaweed) on the shore – circle appropriate measure
5) Comments on site conditions, including any signs posted (such as use restrictions, warnings, closures, etc.), and other notable site conditions (such as heavy erosion, difficult access, etc.)
6) Water conditions – assessment of water quality and listed aspects of water quality – check appropriate level for each
7) Comments on water conditions
8) Weather conditions
    1) Amount of cloud cover – circle appropriate level in the column for the time recorded
    2) Precipitation – circle appropriate level in the column for the time recorded
    3) Wind speed – circle appropriate level in the column for the time recorded, and enter estimate of wind speed
    4) Wind direction – circle direction in the column for the time recorded
9) Comments on weather conditions

Note: The conditions listed on these sheets are those that we found to be useful for our work. You may have alternative or additional interests based on how you plan to use the data. For example, you may want to record wave height or note site amenities (restrooms, etc.) and their condition.

Site Conditions

Date:_____

Observer Name(s):_____ Site: _____

Shore Conditions:

Attribute	1	2	3	4	5
Trash and litter	A lot		Some		None
Amount of algae on beach	A lot		Some		None

Comments on shore and overall site conditions (posted warnings, closures, parking restrictions, or other notable site conditions)

Water Conditions:

Worst possible quality: may have bad odor, oil, raw sewage, unhealthy for plant and animal life.

1 2 3 4 5 6 7 8 9 10

Best possible quality: clear, safe for all activities, never has closures, healthy for plant and animal life.

Aspects	Worst Quality	1	2	3	4	5	6	7	8	9	10	Best Quality	Don't Know
Seaweed	Wide spread	O	O	O	O	O	O	O	O	O	O	None	O
Algae/scum	Wide spread	O	O	O	O	O	O	O	O	O	O	Absent	O
Bacteria	Excessive	O	O	O	O	O	O	O	O	O	O	Absent	O
Clarity of the water	Murky	O	O	O	O	O	O	O	O	O	O	Clear	O
Mucky bottom condition	Very mucky	O	O	O	O	O	O	O	O	O	O	Not at all mucky	O
Oil or gas sheen	Common	O	O	O	O	O	O	O	O	O	O	Rare	O
Smell/odor	Bad odor	O	O	O	O	O	O	O	O	O	O	Fresh	O
Trash in water	Common	O	O	O	O	O	O	O	O	O	O	Rare	O

Comments on water conditions

Data entered by:_____ Date entered:_____ Data sheet #_____

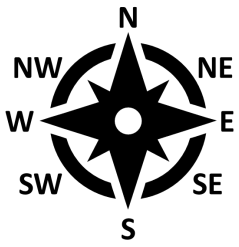
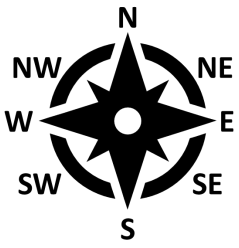
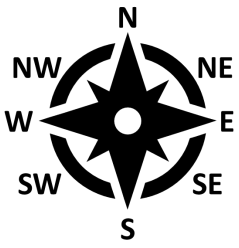
Site Conditions

Date:_____

Observer Name(s):_____

Site: _____

Weather Conditions:

Attribute	**Morning (8AM-10AM)**	**Midday (10AM - 2PM)**	**Afternoon (2PM-4PM)**
Cloud Cover	None 25% 50% 100%	None 25% 50% 100%	None 25% 50% 100%
Rain	None Drizzle Light Rain Rain Downpour	None Drizzle Light Rain Rain Downpour	None Drizzle Light Rain Rain Downpour
Wind Speed	Calm Light breeze Moderate Strong Gale	Calm Light breeze Moderate Strong Gale	Calm Light breeze Moderate Strong Gale
Mph estimate			
Wind Direction (direction from which wind is blowing)			

Comments on weather conditions

Data entered by:_____ Date entered:_____ Data sheet #_____

APPENDIX E - SCREENSHOTS FROM NARRAGANSETT BAY PERIODIC COUNT DATA ENTRY

Enter your car count data below. When you are ready to view results, click the "Refresh Results" button above.

The "Time" column uses a drop-down list - click on the cell to acess the drop-down.

Data Entry Table (rows will be added automatically as you enter data)

Date (m/d/yy)	Site Name	Site type:	Time (Click dropdown on cell)	Number of Cars
7/2/18	E. Greenwich	boat ramp	1-2 PM	8
7/25/18	E. Greenwich	boat ramp	1-2 PM	7
8/15/18	E. Greenwich	boat ramp	8-9 AM	2
7/17/18	Goddard	park	10-11 AM	20
7/23/18	Goddard	park	2-3 PM	9
8/14/18	Goddard	park	8-9 AM	17
6/21/18	Salter	landing	1-2 PM	2
7/17/18	Salter	landing	8-9 AM	9
8/6/18	Salter	landing	1-2 PM	3
8/24/18	Salter	landing	8-9 AM	4
6/30/18	Barrington	beach	9-10 AM	20
7/5/18	Barrington	beach	9-10 AM	10
8/29/19	Barrington	beach	1-2 PM	30
7/15/18	Bristol	beach	1-2 PM	50
8/2/18	Bristol	beach	1-2 PM	50
6/23/18	Warren	beach	10-11 AM	3
7/11/18	Warren	beach	9-10 AM	20
7/15/18	Warren	beach	3-4 PM	40
8/2/18	Warren	beach	2-3 PM	25
7/23/18	B Tuft	park	1-2 PM	1

Figure E-1: Portion of data entry sheet for Narragansett Bay 2018 periodic counts.

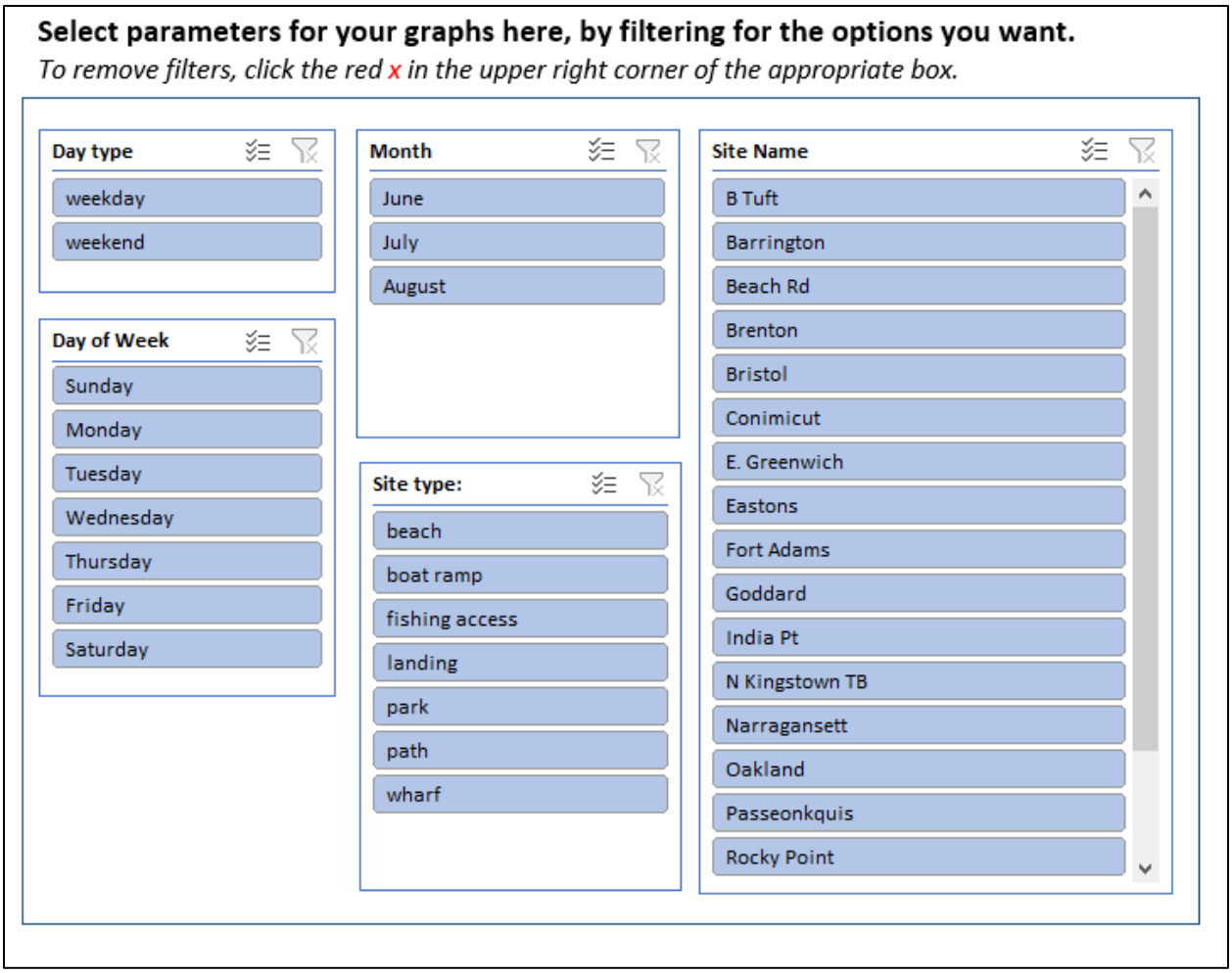


Figure E-2: Filters for report results.

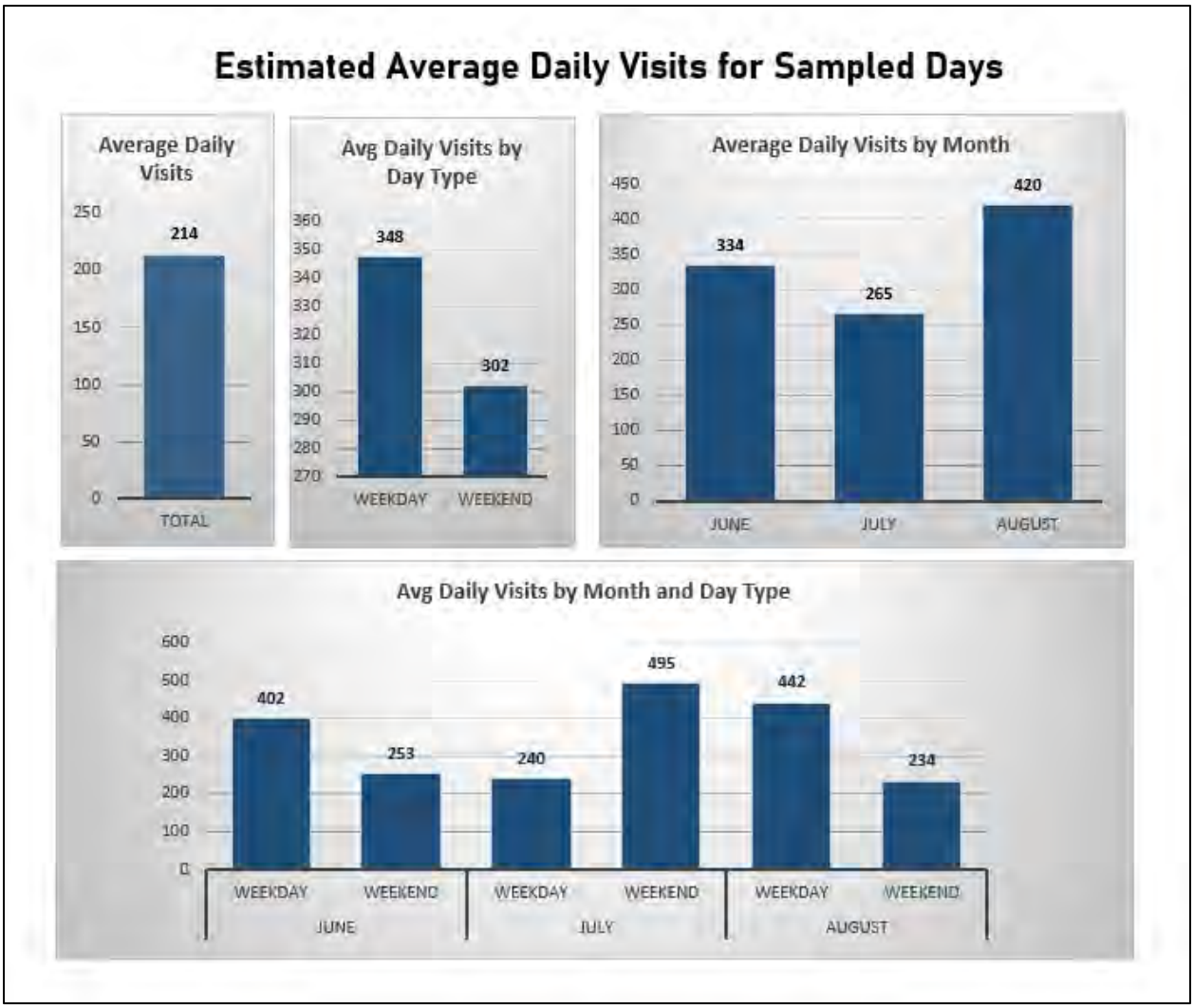


Figure E-3: Charts from results report.

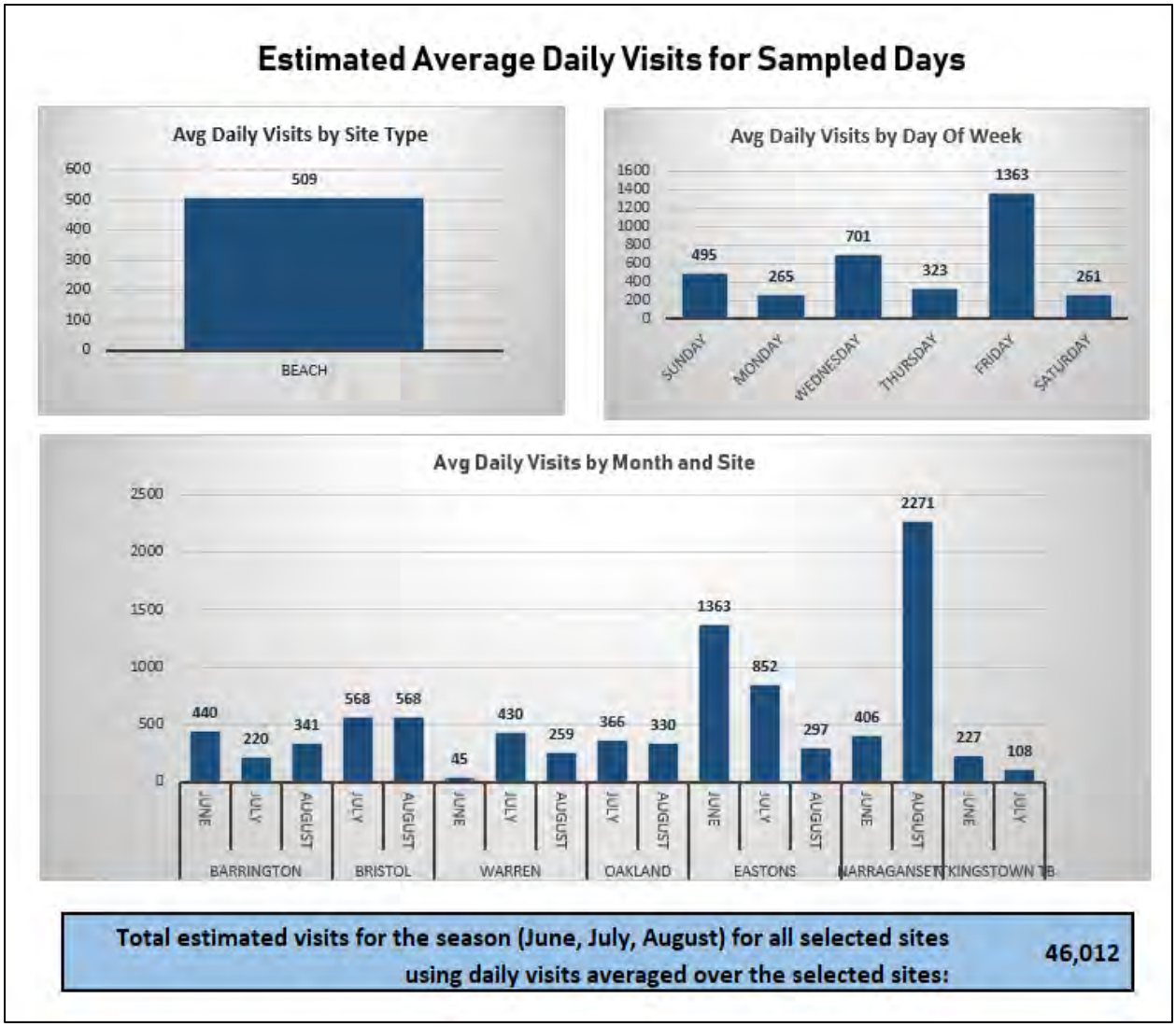


Figure E-4: Charts from results report (filtered to show beaches only).

Summary Table

Date (m/d/yy)	Site Name	Site type:	Year	Month	Day type	Day of Week	Estimated Visits
7/2/18	E. Greenwich	boat ramp	2018	July	weekday	Monday	91
7/25/18	E. Greenwich	boat ramp	2018	July	weekday	Wednesday	79
8/15/18	E. Greenwich	boat ramp	2018	August	weekday	Wednesday	54
7/17/18	Goddard	park	2018	July	weekday	Tuesday	301
7/23/18	Goddard	park	2018	July	weekday	Monday	93
8/14/18	Goddard	park	2018	August	weekday	Tuesday	460
6/21/18	Salter	landing	2018	June	weekday	Thursday	23
7/17/18	Salter	landing	2018	July	weekday	Tuesday	243
8/6/18	Salter	landing	2018	August	weekday	Monday	34
8/24/18	Salter	landing	2018	August	weekday	Friday	108
6/30/18	Barrington	beach	2018	June	weekend	Saturday	440
7/5/18	Barrington	beach	2018	July	weekday	Thursday	220
8/29/19	Barrington	beach	2019	August	weekday	Thursday	341
7/15/18	Bristol	beach	2018	July	weekend	Sunday	568
8/2/18	Bristol	beach	2018	August	weekday	Thursday	568
6/23/18	Warren	beach	2018	June	weekend	Saturday	45
7/11/18	Warren	beach	2018	July	weekday	Wednesday	440
7/15/18	Warren	beach	2018	July	weekend	Sunday	421
8/2/18	Warren	beach	2018	August	weekday	Thursday	259
7/23/18	B Tuft	park	2018	July	weekday	Monday	11
8/14/18	B Tuft	park	2018	August	weekday	Tuesday	91
6/20/18	Rocky Point	park	2018	June	weekday	Wednesday	341
8/14/18	Rocky Point	park	2018	August	weekday	Tuesday	297
8/19/18	Rocky Point	park	2018	August	weekend	Sunday	170
7/2/18	Oakland	beach	2018	July	weekday	Monday	421
7/25/18	Oakland	beach	2018	July	weekday	Wednesday	310
8/15/18	Oakland	beach	2018	August	weekday	Wednesday	330
8/14/19	Conimicut	park	2019	August	weekday	Wednesday	330
8/19/19	Conimicut	park	2019	August	weekday	Monday	1053
7/17/18	Passeonkquis	fishing access	2018	July	weekday	Tuesday	21
6/30/18	Fort Adams	park	2018	June	weekend	Saturday	257
7/5/18	Fort Adams	park	2018	July	weekday	Thursday	227
8/2/18	Fort Adams	park	2018	August	weekday	Thursday	270
6/30/18	Brenton	park	2018	June	weekend	Saturday	414
7/5/18	Brenton	park	2018	July	weekday	Thursday	421
8/2/18	Brenton	park	2018	August	weekday	Thursday	220
8/18/18	Eastons	beach	2018	August	weekend	Saturday	297

Figure E-5: Summary table from results report.

APPENDIX F - SCREENSHOTS FROM NARRAGANSETT BAY FOUR-HOUR COUNTS

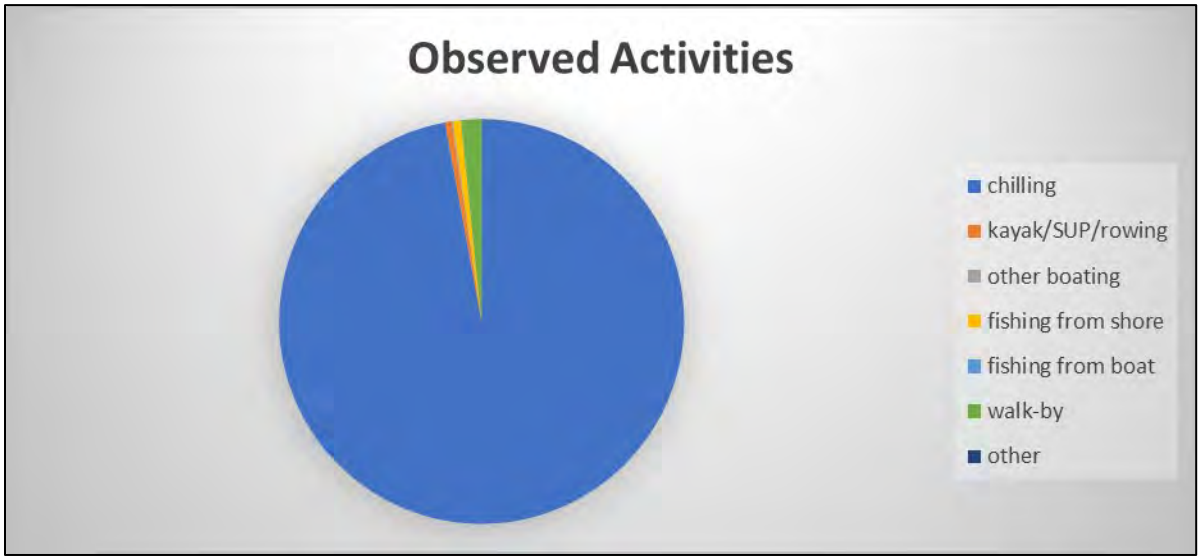


Figure F-1: Summary of observed activities.

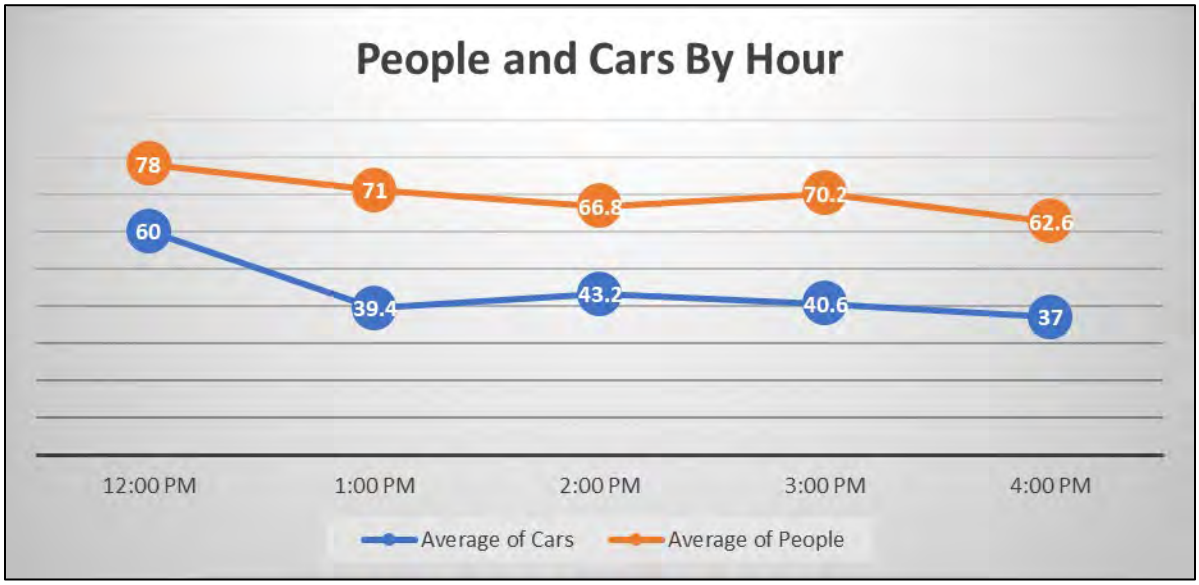


Figure F-2: Average observed people and cars by hour.

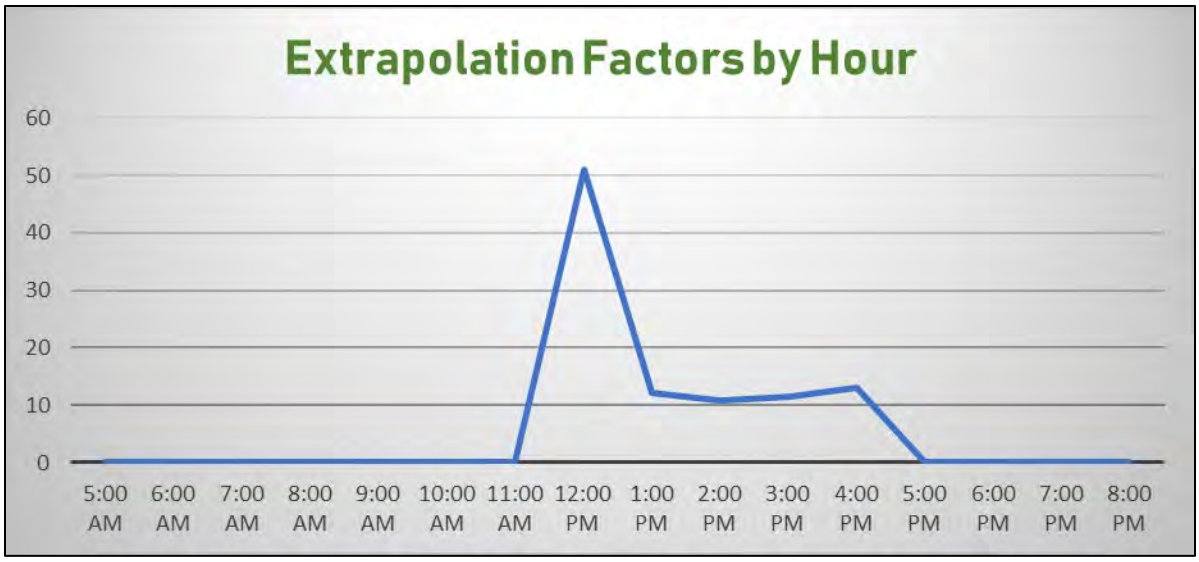


Figure F-3: Extrapolation factors by hour.

Overall People Per Car

Total	People Per Car (Counted)	People Per Car (Estimated)
Total	1.50	1.71

Figure F-4: Summary of people per car.

Extrapolation Factors

Time	Turnover Factor	Extrapolation Factor
5:00 AM	0	#NUM!
6:00 AM	0	#NUM!
7:00 AM	0	#NUM!
8:00 AM	0	#NUM!
9:00 AM	0	#NUM!
10:00 AM	0	#NUM!
11:00 AM	0	#NUM!
12:00 PM	0.01958825	51.05101272
1:00 PM	0.081845857	12.21808936
2:00 PM	0.093105372	10.74051879
3:00 PM	0.087073652	11.48453031
4:00 PM	0.076029958	13.15271008
5:00 PM	0	#NUM!
6:00 PM	0	#NUM!
7:00 PM	0	#NUM!
8:00 PM	0	#NUM!

Figure F-5: Extrapolation factors for 4-hour counts.